

Research Note 83-26

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TESTING AND TRAINING METHODS FOR SKILL
QUALIFICATION TESTING (SQT)

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Human Resources Research Organization



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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report presents a classification system for tasks and items in the SQT Written Component (WC) to help one decide whether that is the best means of testing. Ways of eliminating extraneous reading in WC are discussed. A new form of testing is described, combining the convenience of machine scoring with some advantages of hands-on testing. A unit training strategy for SQT preparation is derived from the performance-oriented model, and developments needed for implementation are discussed.		

FOREWORD

The Fort Hood Field Unit of the US Army Research Institute of the Behavioral and Social Sciences (ARI) conducts research in a variety of areas related to the needs of the Army in the field. This report addresses one such area, Skill Qualification Testing (SQT) in combat units. This report deals specifically with methods of selecting the best forms of testing for various kinds of military tasks.

The modern Army requires large numbers of people with a wide variety of specialized skills. SQT is designed to provide a valid assessment of those individual skills to assure a high level of combat readiness. As a criterion-referenced system, SQT involves measuring skills actually used on the job or in combat, applying the standards of successful performance. There have been complaints that the Written Component (WC) of the SQT depends too much upon reading ability that is not required on the job. On the other hand, WC has many advantages over the Hands-On Component (HOC), especially convenience and ease of scoring, and some kinds of tasks seem quite amenable to WC testing.

This report presents a classification system of tasks and test questions, which was developed to help one decide when to use WC testing, and when HOC testing is needed. Refinements of item format are suggested, including a kind of problem that combines the convenience of multiple-choice responses with other advantages of HOC testing. A unit training strategy for SQT is derived from the performance-oriented model.

The research described in this report was performed by personnel of the Human Resources Research Organization (HumRRO), under Contract No. MDA903-79-C-0191. This research is responsive to the objectives of RDTE Project 2Q263739A793, "Human Performance in Field Assessment," FY 1980 Work Program.



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TESTING AND TRAINING METHODS FOR SKILL QUALIFICATION TESTING (SQT)

BRIEF

Requirement:

The impetus for the work described in this report is the common complaint that the Written Component (WC) of Skill Qualification Testing (SQT) depends too much upon reading ability, despite its practical orientation. A previous report (Miller, Nystrom, & Hicks, 1980) assessed the relationship between reading ability and success on the SQT. This report describes a variety of developments for using the SQT system to best advantage.

A major objective was to distinguish the kinds of tasks and items where WC is content valid, and the most cost-effective method of testing. A related objective was to develop a method for eliminating difficult reading required in WC that is not a part of the job. Other objectives include: (1) development of a unit training strategy for SQT, (2) refinement of testing methods, both for diagnostic testing in the units and for use in the SQT itself, and (3) determination of task information requirements for SQT.

Procedure:

Taxonomies of tasks and test questions were developed by sorting content descriptors derived from the 1977 SQT for 11B2, 11C2, and 11E2. A unit training strategy was derived from the performance-oriented model. Training and testing methods were developed for use with the training strategy.

Principal Findings:

- Many kinds of soldier tasks may be validly tested within WC, where HOC is either infeasible or unnecessary. These include processing fire commands for a mortar, plotting missions for a mortar, map reading, vehicle identification, and reacting to flares in combat.
- WC questions may be simplified by eliminating extraneous expressions and by integrating answer choices with illustrations.
- A common limitation of WC is that it tests only short segments of procedures. Longer segments may be tested by using a kind of serial response problem that combines the convenience of multiple-choice responses with other advantages of HOC testing.
- If units are to use a train-to-criterion strategy to prepare for SQT, they need efficient diagnostic tests, which are currently unavailable.
- Reviewers of SQT items need to insure that there is sufficient information in accessible publications to determine the correct answers.

Utilization of Findings:

A taxonomy was developed for helping one decide when to use WC for testing, and when to use HOC.

Test reviewers should be given the means to insure that soldiers studying for SQT can find needed information in accessible publications.

Test developers should also generate equivalent form items for use in diagnostic testing and practice, and disseminate them to units.

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Chapter 1

INTRODUCTION

Problem

Skill Qualification Testing (SQT) is being developed and applied in an increasing number of Army jobs. In FY 1979, a total of 456 SQT tests were developed and administered for various Military Occupational Specialties (MOS) and levels.

SQT is widely acknowledged as a significant advance over the previous "knowledge-based" MOS tests, which often involved information that had dubious relevance in job performance, and normative standards that were similarly suspect. The SQT, as a "criterion-referenced" system, is concerned with measuring skills actually used on the job, applying the standards of successful performance. SQT tests consist of three parts: (1) a Written Component (WC) which involves printed questions and multiple choice, machine-scored answers, (2) a Hands-On Component (HOC) which involves performance with actual job equipment or simulators, evaluation by a trained scorer, and (3) a Performance Certification Component (PCC) which involves performance in an environment that cannot be readily duplicated in a test situation (e.g., rifle marksmanship).

However, there have been widespread complaints by both commanders and troops that the WC still depends too much upon reading ability, despite the practical orientation of the tests. One consequence of the criticism has been to reduce the length of the WC and its relative importance in the scoring. For instance, the 1980 11B2 SQT includes only 12 tasks in the Skill Component (SC)¹ and 14 tasks tested in the HOC. In 1977, the corresponding SQT had 35 WC scoring units, and only 7 HOC scoring units. In other words, the 5 to 1 preponderance of WC in 1977 has shifted to a balance slightly favoring HOC in 1980.

On the other hand, WC has some unique advantages, of which the most obvious are convenience and ease of scoring. The HOC requires several testing stations, trained scorers, and considerable equipment and services in support of test operations. When that kind of operation is used Army-wide for high density MOS, the problems are multiplied. Other kinds of problems are involved with HOC testing of reserve units and of the numerous low density MOS. There is reluctance to allocate such resources for HOC unless it is absolutely necessary.

It seems apparent also that some kinds of soldier tasks can be simulated quite well in WC testing. For instance, map reading involves operations that can be performed quite well in the WC situation. Some kinds of information that is job relevant may be difficult to test with HOC (e.g., "What is the maximum range of the M203 grenade launcher?"). It would be desirable to distinguish various kinds of Army tasks that may be tested validly with WC, to help those who must decide what kind of test to use for which tasks. That is a major objective of the present report.

¹The WC has been renamed the SC for 1980.

Other objectives of this research include various developments in both training and testing to make SQT work as a total system. For those kinds of tasks where WC is appropriate, refinements are suggested to minimize extraneous reading and to increase realism. For those tasks where WC testing is questionable, ways of overcoming the limitations are suggested. In particular, another kind of testing is suggested for many procedural tasks, combining the convenience of machine scoring with other advantages of HOC testing. A unit training strategy for SQT is outlined, based upon the performance-oriented model, which involves practice until a specified criterion is met. Techniques are described for insuring that soldiers have adequate information to perform the tasks targeted by SQT.

Background

Hicks² administered a questionnaire to soldiers who took the 1977 SQT, to determine their opinions about the SQT and the training they received for it. He reported that about "two thirds of the soldiers expressed satisfaction with the Skill Qualification Testing System." Of particular relevance for the present study is the fact that most soldiers received their Soldier's Manual (SM) less than six months before testing, contrary to the goal according to the SQT handbook. However, almost all soldiers in the sample (90%) received their SM two months or more before testing. Almost half (43%) of the soldiers who read their SM reported some difficulty in understanding them. Also, almost half (46%) of the soldiers reported some difficulty in understanding questions on the WC of the SQT.

Another study³ investigated the importance of reading ability and other variables in SQT performance. That study analyzed a data base that included the Hicks questionnaire results, scores on SQT, scores on a standard reading achievement test and various demographic data. Scores on WC correlated substantially with reading level ($r = .46$). But part of that correlation was attributed to a general factor, rather than particular reading skills, since HOC scores also correlated significantly with reading level ($r = .25$). (These correlations are statistically significant; $N = 255$). Analysis of questionnaire data and SQT scores indicated that the SM were a particularly critical channel of task information for the WC. Factors that were correlated significantly with WC included: getting the SM early, studying the SM, understanding the SM, and understanding the WC questions. It did not appear to make a significant difference what their career motivation was, or what they thought of their unit's SQT training program.

²J. A. Hicks, III. Skill qualification test (SQT) opinion survey: 11B's, 11C's, and 11E's (Research Memorandum 78-8). Alexandria, Virginia: US Army Research Institute for the Behavioral and Social Sciences, March 1978.

³E. E. Miller, C. O. Nystrom, & J. A. Hicks, III. Reading ability and other correlates of the SQT written component (FR-MTRD(TX)-80-1). Alexandria, Virginia: Human Resources Research Organization, March 1980. (ARI Technical Report in progress.)

A questionnaire by Yates⁴ assessed the impact of SQT in USAREUR for infantry units. Her results pinpointed some administrative and training problems including: getting the SM distributed on time (six months before testing), criticism of the preparation of some training NCOs, shortages of materials and equipment, other activities interfering with training, and nontesting of some eligible personnel.

⁴L. G. Yates. The estimated impact of SQT on USAREUR infantry units: Survey results (Research Problem Review 79-9). Alexandria, Virginia: US Army Research Institute for the Behavioral and Social Sciences, June 1979.

Chapter 2

TASK CLASSIFICATION

Method

In order to develop a classification of scoring units that would distinguish the appropriateness of Written Component (WC) testing, a wide range of examples were needed. All of the 1977 SC for 11B2 (Track 1), 11C2 (Track 1), and 1E2 (Track 1) were included (infantryman; indirect fire infantryman, 81mm; and M60A1 armor crewman, respectively). These tests had a wider range of items than later WCs. A substantial data base of SQT scores, reading scores, and other correlates was available to indicate the performance factors involved.

First, a classification was developed for the scoring units and the corresponding soldier tasks. The classification was designed to group tasks according to similarity of operations and operating environment, especially as those variables related to testing. Task analysis was used to derive the salient characteristics for scoring units. With these considerations in mind, the tasks were organized into a taxonomy by means of a technique called "connotative clustering."⁵ That involved writing each task title on a separate slip of paper, and sorting the tasks into clusters on the basis of similarities of test conditions, with distances between clusters representing relatedness. The clusters were rearranged until a useful hierarchy of categories was developed.

Results

The resulting taxonomy is presented in Table 2-1, and the scoring units are classified in Table 2-2. WC testing seems valid for some of the categories, and its application in other categories is questionable for reasons that are discussed below. Validity is construed here in the sense of content validity, that is, requiring the same operations for the test as are involved in performance of the tasks.

In classifying a particular scoring unit, one should first determine the major category by asking a series of questions, as flowcharted in Figure 2-1. The sequence of asking the questions is important, because some of the later categories presume some of the earlier questions.

Information Processing (Categories I and II)

The first question is to determine whether some simplifying assumptions can be made. If the task involves no significant equipment, people or environment, then it is very easy to represent the situation in a WC item. The critical process is mental. This is not to say that the other categories do not involve mental processes; but they involve other significant elements that may be difficult to describe or to picture.

⁵ E. E. Miller. A taxonomy of responsive processes (Technical Report 69-16). Alexandria, Virginia: Human Resources Research Organization, September 1969.

Table 2-1
Task Situational Taxonomy

- | | |
|---|--|
| I. Paperwork (no equipment involved) <ul style="list-style-type: none"> A. Standard forms, making entries B. Paper display, work with (maps, charts, etc.) C. Both forms and display | V. Procedures, Machine-Ascendant (operate on machine) <ul style="list-style-type: none"> A. Preparation of machine for action <ul style="list-style-type: none"> 1. Aline (with environmental features) 2. Inspect and adjust <ul style="list-style-type: none"> (1) Ammunition (2) Vehicle or weapon B. Operate equipment (except target engagement) <ul style="list-style-type: none"> 1. Driving and starting 2. Switch, hookup (product, not process) 3. Emergency actions C. Maintain (check, clean, lubricate, etc.) |
| II. Mental Work (except paperwork) <ul style="list-style-type: none"> A. Operations, gross <ul style="list-style-type: none"> 1. Plan 2. Standing Operating Procedures (SOP) B. Elements <ul style="list-style-type: none"> 1. Calculate 2. Coding and Conventions | VI. Operate on Battlefield (man-ascendant) <ul style="list-style-type: none"> A. Tactical B. Procedural <ul style="list-style-type: none"> 1. Construct or camouflage 2. Procedure on person (survival) 3. Other procedures |
| III. Identify Threat Equipment | VII. Interpersonal Rules |
| IV. Target Engagement <ul style="list-style-type: none"> A. Aiming, using sight picture B. Engaging without sight picture <ul style="list-style-type: none"> 1. Operate 2. Call for fire | |

Table 2-2

Classification of Scoring Units, 1977 SQT 2 for 11B, 11C, 11E

I. Paperwork (no equipment involved)

A. Standard forms, making entries

- 11C Determine data for sheaf adjustment, U28, p. 56
- 11C Determine information firing data sheet (81 mm), U29, p. 58
- 11C Prepare a firing chart for operation and determine initial firing data, U27, p. 71
- 11C Determine data for sheaf adjustment, U28, p. 72
- 11C Record information on firing data sheet (107 mm/4.2 in., U29, p. 74

B. Paper display, work with (maps, charts, etc.)

- 11B Navigate from one position on the ground to another point, U18, p. 33
- 11C Determine a grid azimuth between two given points on a map, U10, p. 19
- 11C Prepare M16 plotting board for operation, U27, p. 55
- 11E Measure ground distances using map, U19, p. 28

C. Both forms and display

- 11C Process subsequent forward observer (FO) corrections, using M16 plotting board, U20, p. 35

I. Material Work (except paperwork)

A. Operations, gross

1. Plan

- 11C Assist unit commanders in the preparation of a fire support plan, U19, p. 34

2. Standing Operating Procedures (SOP)

- 11B Perform a wheeled vehicle equipment serviceability criteria (ESC) inspection, U19, p. 34
- 11C Perform an equipment serviceability criteria (ESC) inspection on a wheeled vehicle, U22, p. 44

B. Elements

1. Calculate

- 11C Convert a magnetic azimuth to a grid azimuth (or grid azimuth to magnetic azimuth), U11, p. 20

Table 2-2 (continued)

2. Coding and conventions

- 11B Use challenge and password, U14, p. 25
- 11B Transmit or receive a radio message, U16, p. 29
- 11C Use challenge and password, U7, p. 14
- 11E Communicate, using visual signal techniques, U9, p. 10
- 11E Enter/leave radio communications net, using communication-electronics operating instructions (CEOI), U20, p. 30

III. Identify Threat Equipment

- 11B Identify threat vehicles and weapons, U13, p. 23
- 11C Identify threat vehicles and weapons, U8, p. 15
- 11E Identify combat aircraft, U1, U2, p. 3
- 11E Identify combat vehicles and weapons, U3, U4, p. 3

IV. Target Engagement

A. Aiming, using sight picture

- 11B Engage targets with an M203 grenade launcher (and apply immediate action to reduce a stoppage), U23, p. 43
- 11B Engage targets with a 90mm recoilless rifle, U30, p. 54
- 11B Engage targets with an M72A2 LAW, U32, p. 58
- 11C Engage targets with the M203 grenade launcher (and apply immediate action to reduce a stoppage, U14, p. 25
- 11E Use precision fire, U24, p. 41
- 11E Use battlesight, U25, p. 44
- 11E Adjust fire from a subsequent fire command, U26, p. 47
- 11E Adjust fire using burst on target, U27, p. 50

B. Engaging without sight picture

1. Operate

- 11B Engage enemy targets with hand grenades, U25, p. 46
- 11B Fire a Claymore mine, U26, p. 48
- 11C Adjust fire without a fire direction center (FDC), U23, p. 46
- 11C Engage target using fire without fire direction center (FDC), U35, p. 67
- 11C Engage target using fire without fire direction center (FDC), U35, p. 84
- 11E Engage targets (and apply immediate action) to an M85 caliber .50 machinegun, U18, p. 27
- 11E Fire from a range card, U30, p. 56

2. Call for fire

- 11B Call for/adjust indirect fire (using grid coordinate method of target location and bracketing method of adjustment), U35, p. 65
- 11C Call for/adjust indirect fire (using grid coordinate method of target location and the bracketing method of adjustment), U16, p. 29

Table 2-2 (continued)

- 11C Call for/adjust a screening mission, U17, p. 32
11C Call for/adjust a coordinated high explosive and illumination mission, U18, p. 33

V. Procedure, Machine-Ascendant (operate on machine)

A. Preparation of machine for action

1. Aline (with environmental features)

- 11B Zero an M16A1 rifle, U21, p. 39
11B Zero the AN/PVS-2 when mounted on an M16A1 rifle, U34, p. 64
11C Zero an M16A1 rifle, U13, p. 22
11C Lay mortar for direction, using direct alignment method (fire without fire direction center [FDC]), U24, p. 48
11C Lay mortar for direction using M2 aiming circle, U25, p. 49
11C Lay mortar for direction using M2 compass, U26, p. 51
11C Boresight 81mm mortar, U30, p. 60
11C Boresight 107mm mortar, U30, p. 76
11E Prepare a range card for a tank, U21, p. 32
11E Select and occupy firing positions, U22, p. 38
11E Zero a main gun, U28, p. 54

2. Inspect and adjust

(1) Ammunition

- 11C Prepare 81mm mortar ammunition for firing, U32, p. 63
11C Prepare 107mm (4.2 in) mortar ammunition for firing, U32, p. 79

(2) Vehicle or weapon

- 11C Perform safety checks on 81mm mortar, U31, p. 61
11C Perform safety checks on 107mm (4.2 in) mortar, U31, p. 77
11E Perform loader prepare-to-fire checks, U11, p. 15
11E Perform before-, during-, and after-operation maintenance checks and services on an M60 series tank, U12, p. 16
11E Perform prepare-to-fire checks, U23, p. 40

B. Operate equipment (except target engagement, see below)

1. Driving and starting

- 11E Start and stop a tank engine, U13, p. 18
11E Operate a tank, U14, p. 19

2. Switch, hookup (product, not process)

- 11B Install/operate field telephones (TA-1 & TA-312), U17, p. 30
11C Install/operate field telephones (TA-1 & TA-312), U21, p. 42
11E Operate tactical FM radio and accessories, U10, p. 12

Table 2-2 (continued)

3. Emergency actions

- 11B Load, reduce a stoppage, unload, and clear an M16A1 rifle, U20, p. 36
- 11B (Engage targets with an M203 grenade launcher) and apply immediate action to reduce a stoppage, U23, p. 43
- 11B Apply immediate action to correct a malfunction on an M72A2 LAW, U31, p. 58
- 11C Load, reduce a stoppage, unload, and clear an M16A1 rifle, U12, p. 20
- 11C (Engage targets with an M203 grenade launcher) and apply immediate action to reduce a stoppage, U14, p. 25
- 11C Remove a misfire from the 81mm mortar, U34, p. 66
- 11C Remove a misfire from the 107mm (4.2 in) mortar, U34, p. 82
- 11E Extinguish a fire in a tank, U8, p. 9
- 11E (Engage targets) and apply immediate action to an M85 caliber .50 machinegun, U18, p. 27
- 11E Use misfire procedures for a 105mm main gun, U29, p. 55

C. Maintain (check, clean, lubricate, etc.)

- 11B Maintain protective mask and accessories, U4, p. 8
- 11B Maintain an M203 grenade launcher and ammunition, U24, p. 44
- 11B Maintain a caliber .45 pistol and ammunition, U29, p. 51
- 11C Maintain protective mask and accessories, U2, p. 6
- 11C Maintain a caliber .45 pistol and ammunition, U15, p. 27
- 11C Maintain 81mm mortar and associated fire control equipment, U33, p. 65
- 11C Maintain 107mm (4.2 in) mortar and equipment, U33, p. 81

VI. Operate on Battlefield (man-ascendant)

A. Tactical

- 11B Move over, through, or around obstacles, U6, p. 14
- 11B Move under direct fire, U7, p. 14
- 11B React to flares, U8, p. 16
- 11B Select temporary battlefield positions, U9, p. 18
- 11B Take cover as protection against nuclear, biological, and chemical (NBC) hazards, U2, p. 6
- 11C Move under direct fire, U5, p. 11
- 11C React to flares, U6, p. 13
- 11C Take cover as protection against nuclear, biological, and chemical (NBC) hazards, U3, p. 8
- 11E Select temporary tank firing position, U15, p. 22

B. Procedural

1. Construct or camouflage

- 11B Camouflage/conceal self and individual equipment, U5, p. 10
- 11B Construct individual defensive positions, U10, p. 19
- 11B Prepare and use aiming and firing stakes for the M16A1 rifle, U22, p. 41

Table 2-2 (continued)

- 11B Camouflage/conceal defensive positions, U11, p. 21
- 11B Emplace/recover pyrotechnic early warning devices, U15, p. 27
- 11C Construct mortar position, U19, p. 18

2. Procedure on person (survival)

- 11B Apply the four lifesaving measures, U1, p. 4
- 11B Administer antidote to a nerve-agent casualty, U3, p. 8
- 11C Apply the four lifesaving measures, U1, p. 4
- 11C Administer antidote to a nerve-agent casualty, U4, p. 10
- 11E Decontaminate self, equipment, weapon, supplies, and tank, U5, p. 4
- 11E Administer artificial respiration (mouth-to-mouth), U6, p. 6
- 11E Administer atropine injection, U7, p. 7

3. Other procedures

- 11B Detect enemy mines, U27, p. 48
- 11B Destroy a mine in place, U28, p. 50
- 11E Recover a tank by self-discovery means, U16, p. 24

VII. Interpersonal Rules

- 11B Process known or suspected enemy personnel, U12, p. 21
- 11E Process known or suspected enemy personnel, U17, p. 25

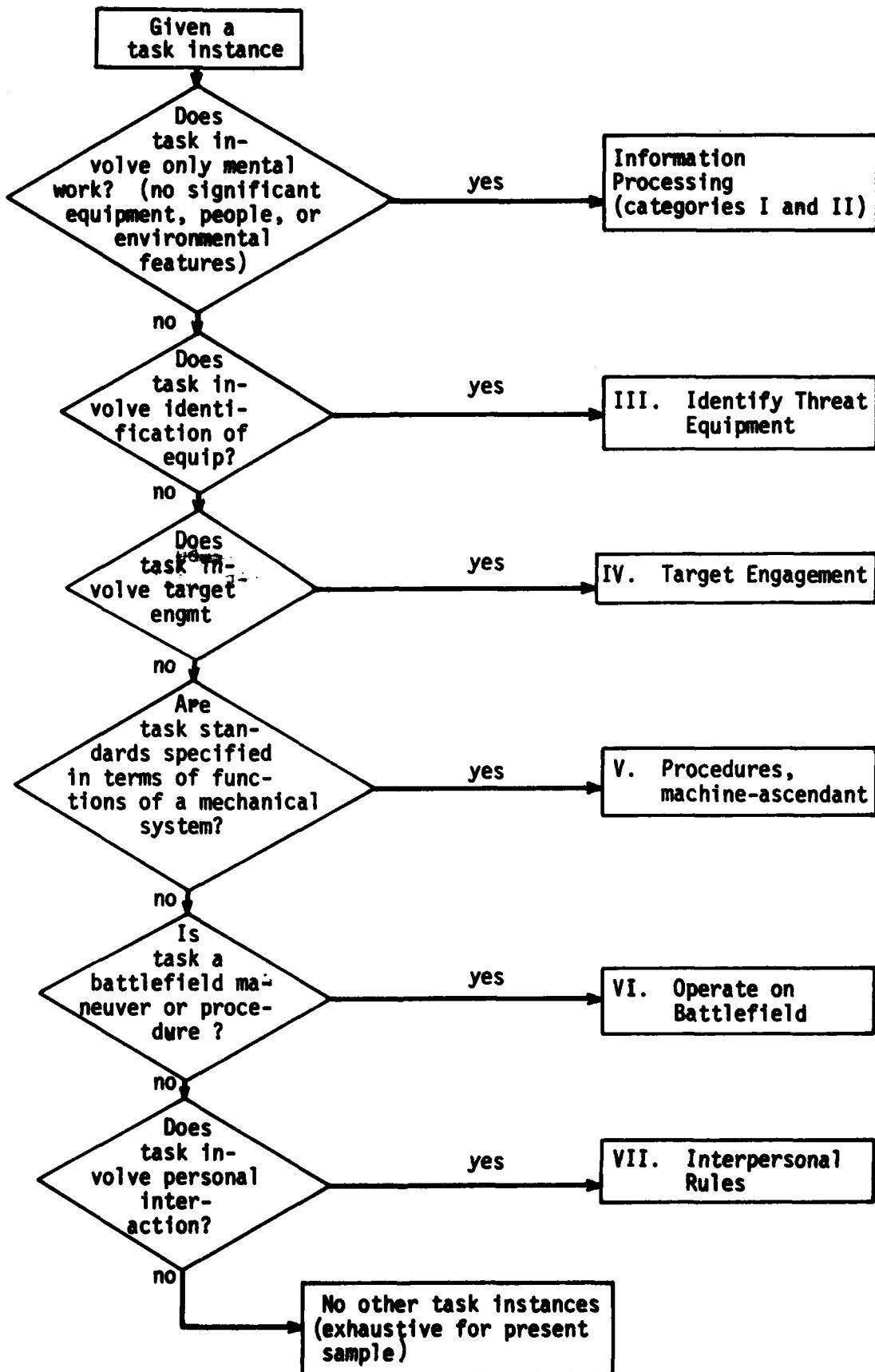


Figure 2-1. Flow chart for determining major category of a task.

Information processing tasks all involve well-defined operations (like math), use only a minimum of equipment (which is available in the test situation), and involve only responses that can be matched with written answer choices. The required response process is also separable from other responses in the situation without appreciably altering the task cues involved.

III. Identify Threat Vehicles

This is another kind of task that is rather easy to test with WC, using pictures or slides of friendly and threat equipment. But validity depends upon imagery having sufficient fidelity, and being well chosen by tactical criteria, such as image size and kind of decision required. Because of practical constraints, it is unlikely that such tasks would ever be tested by HOC.

IV. Target Engagement

Target engagement is a kind of procedure that is readily recognized by military people. It could just as well have been included under the next category (V. Procedures, Machine-Ascendant), but is considered separately because of its importance and because of some special characteristics. Target engagement contributes directly to success of the military mission, and is often performed under stress of time and danger. When a sight picture is involved, there are special kinds of pictorial techniques that are appropriate for training and testing, so that is the basis of a subcategory. Some of the best WC items involve choice of the correct sight picture.

V. Procedures, Machine-Ascendant

This category includes most procedures using machines. "Machine-ascendant" means that the task standards are defined primarily in terms of the functions for which the machine was designed. For instance, installing/operating field telephones is defined in terms of being able to talk to the person at the other end of the line. On the other hand, camouflaging a position is man-ascendant; even though one may use shears and other devices to cut branches, the objective is the appearance of the position, and the cutting of branches is only incidental. But machine-ascendant tasks have distinctive, "mechanical" objectives. Consequently, most military people can identify common tasks of this sort.

Since these tasks are procedures, they have a fairly regular sequence. This is a practical advantage in training and testing. This is also a major disadvantage for testing with WC, because the required responses involve only a short segment of a long chain of responses. The required responses may be critical ones, but there is much more to the procedures than is tested.

A related problem is that the responses in a procedural chain depend on cues from having performed the previous responses, as well as cues from the general situation. When isolated responses are required, there is the difficulty in representing cues realistically. There is a danger in overprompting (giving too many hints) or leaving out cues, or giving unrealistic cues. Also, giving all the cues is time consuming, especially if only one response is involved.

There are many differences among the various categories of procedures, but these will be discussed in Chapter 3. As the task taxonomy was developed, it became apparent that further distinctions were needed, at a more detailed level, in order to describe relevant features of the response processes. A more coherent picture of procedural processes can be given later, as the second taxonomy is discussed. For some kinds of procedural responses, the multiple choice feature of WC is a limitation, but for others it is not.

VI. Operate on Battlefield (Man-Ascendant)

This category includes various and sundry other kinds of tasks, which are best described by what they are not. They are not purely mental operations, they are not identification, and they are not defined in terms of machine functions. This is because the previously discussed categories must be considered first in classifying a task.

The first subcategory (A. Tactical operations) includes various maneuvers and sudden choices made on the battlefield. An example is reacting to flares. Such instances are too brief or too variable to be considered as procedures; there is no practical advantage for doing so. The brevity precludes problems associated with interrupting a long chain of responses, so the task situation is usually easy to describe in WC items.

Procedures of this sort (subcategory B) are somewhat harder to specify than other (machine-ascendant) procedures. In particular, it is difficult to picture effective camouflage patterns, or various symptoms associated with survival procedures.

VII. Interpersonal Rules

This category includes application of rules for personal interactions (e.g., processing enemy personnel). Such tasks do not have the regular sequence that characterizes procedures. Usually there is repetitive interaction to achieve a specified result (e.g., not allowing prisoners to talk to each other). Such tasks are not simply following orders or an example, as may be true for tactical operations. Nor is it simply knowing the proper code or signal, which would be simply a kind of "mental" work. Classifying tasks in this category may involve ambiguity, but in such cases it probably will not matter which category is selected. The important thing is to consider what kinds of testing are generally appropriate for each likely category, and select the kind that seems to have the most advantages. Interpersonal skills are almost always tested with WC because the tasks are seldom important enough in this MOS for HOC testing. (But Military Police might be required to act out apprehension of a suspect, because that task is critical for them.)

Even though this category had only one instance, it was considered separately because of its importance at supervisory levels, and in other MOS. Also, such skills seem to involve distinctly different considerations.

Chapter 3
CLASSIFICATION OF QUESTIONS

METHOD

The classification of scoring units had many categories where the appropriateness of Written Component (WC) testing was indeterminate, so another taxonomy was developed for the individual questions. It was hoped that greater detail would clarify the performances required in taking the tests.

The item taxonomy was developed by another application of the "connotative clustering" technique. The elements being sorted were abbreviations of every question in the 11B2 and 11C2 (Track 1) WCs. After formulation of the categories, all questions from 11E2 (Track 1) were classified to test the generality of the item taxonomy.

The general purpose for the item classification was to distinguish the content validity of WC testing, but additional considerations influenced the sorting. These included the difficulties encountered in developing the task taxonomy, especially the problems of testing procedural tasks.

The item classification was to rely more upon formal distinctions, rather than content. The reverse was true of the task classification. The shift in emphasis was an attempt to clarify what a person is required to do in taking a WC test.

A Model for WC Questions

Other considerations involved a more or less explicit model of the process of selecting an answer in an ideal multiple-choice item, including ways in which the process might be subverted. A good example is almost any math problem in which the response alternatives are all apparently reasonable numbers. The model involved the following parts:

1. Situation cues. The question should present the problem quickly and effectively, giving any specific information needed to initiate the required chain of responses. There should be no helpful cues that would be unavailable on the job. The person may glance down immediately to consider the response alternatives, but should not be encouraged to do so. The alternatives should be equally plausible before reckoning the answer. What often happens, unfortunately, is that the person recognizes some alternative as much more likely than the others, and selects the answer without reasoning.

2. Reasoning. The cues should initiate a well-defined reasoning process that is essentially the same as required for the job. The process may involve intermediate overt responses with job equipment or materials (e.g., scratch paper). The result should be an answer that may be compared with the response choices. The reasoning process may be very short (e.g., simple recall) but then plausible distractors may be hard to find (i.e., recall becomes mere recognition).

3. Answer selection. The correct answer should match one of the alternatives with a minimum of interpretation. Plausible distractors may be common mistakes or correct answers to similar questions. The distractors should be distinctly wrong. There should be no process of elimination in which each alternative is compared with every other. Such games put a premium on "test wisdom" rather than job performance. That problem is compounded when answer choices are complicated.

Variation in Response Choices

Early attempts to develop an item classification were not rewarding, until the response alternatives were considered along with the item stem. The number and kind of alternatives are apparently critical in getting the answer.

One kind of response choice warrants particular attention: the choice between "do" and "not do" for a particular operation. The person answering the question tries to look for flaws, rather than to come up with an unprompted response. Sometimes the operation is so innocuous (e.g., "inspect for mildew") that it is a giveaway; the natural reaction is "why not?". It is difficult to imagine that such items are any indication of whether someone would remember to perform the operation on the job.

RESULTS

The classification of items is presented in Table 3-1. In Table 3-2, all items in 11B2, 11C2, and 11E2 WCs are categorized, and the content of each item is described. Table 3-3 is a matrix relating the item taxonomy to the task classification, by classifying items in both systems. As in Chapter 2, the categories are to be considered in the sequence given.

Separable Response Processes

The first distinction to consider is between "Separable Response Processes" and "Procedural Segments." The procedural segments are part of an implied chain of responses, with only part of the chain involved in answering the particular question. The major limitation of procedural items is the parts of the procedure left untested, even though the items may be valid as far as they go. Sometimes there is difficulty in presenting the situation realistically. In contrast to that, the separable response processes involve situations that are easily characterized, well-defined associations or reasoning processes, and responses that may be matched with the answer choices, without leaving a substantial part of the task untested. Virtually all of these kinds of items can be tested validly with WC, with certain reservations about simulation for communication and recognition, which will be noted below.

Deduction. The "Deduction" items are the classic mental or calculating kind of problem. This class is defined by (a) an initial situation that satisfies definite problem parameters, (b) a well-defined reasoning process consisting of several steps, and (c) an answer or conclusion that may be matched with written answer choices without ambiguity. Prominent examples from the tests include map reading, calculation of firing data and other mortar adjustments, and determining entries to standard forms. The

Table 3-1
TAXONOMY OF TEST QUESTIONS IN THE WRITTEN COMPONENT

I. Separable Response Processes

- A. Deduction
 - 1. Performance
 - 2. Recognition of steps
- B. Communication, signals
- C. Recognition of equipment
- D. Decision Making

II. Procedural Segments

- A. Basics
- B. Selection of procedural steps
 - 1. Determination of subtasks
 - a. mechanical
 - b. bodily
 - 2. Selection of materials
 - 3. Manipulation
 - 4. Maintenance
 - a. inspection
 - b. removal
 - c. surface treatment
 - 5. Interpersonal or administrative action
- C. Characteristics of procedural steps
 - 1. Afinement
 - a. pictorial
 - b. descriptive
 - 2. Process characteristics
 - a. quantitative
 - (1) optimal
 - (2) limits (maximum or minimum)
 - b. qualitative
 - 3. Product characteristics

Table 3-2

CLASSIFICATION OF TEST ITEMS IN 11B2, 11C2, and 11E2
WRITTEN COMPONENT, AND CHARACTERIZATION OF CONTENT*

I. Separable Response Processes

A. Deduction

1. Performance

11B: 18-1,2,3,4 From map, get 6-digit coordinate, distance, azimuth,
identify symbol.

11B-C: 19-7 Determine vehicle status, red, amber, green.
35-5,6,7 Determine adjustments, indirect fire.

11C: 10-1,2 On map, determine grid azimuth.
11-1,2 Convert azimuth, magnetic to grid.
17-2,3, 18-1,2,3 Determine corrections for mortar.
20-1,2,3,4,5,6 Process FO corrections, using M16 plotting board.
23-1,2,3,4 Adjust fire without FDC.
24-2 Determine deflection, direct alignment method.
25-1 Determine setting for aiming circle.
28-1,2,3,4,5 Determine sheaf adjustment, which mortar to fire.
29-1,2,3,4 Determine data for computer's record.
35-1,4,5,6,7 Determine deflection, elevation, charge, and corrections
when operating without FDC.

11E: 19-1,2,3,4 Determine ground distances on map.
20-1,2,3,4 Determine authentication codes, radio.
21-1,2,3 Read, justify data on range card.

2. Recognition of steps

11C: 19-1,2,3,4,5,6,7,8,9 In fire support plan, recognize what
characterizes legitimate targets, and whether to issue target
numbers

27-1,2,3,4,5,6,7,8 Recognizes steps in preparing M16 plotting board.

*The 11B, 11C, or 11E items were from the corresponding WC tests, level 2. The
11B-C items were common to 11B2 and 11C2 tests, with item numbering from 11B2.

B. Communication, signals

11B: 16-1,2,3 Compose radio messages.

11B-C: 14-1,2,3 Challenge, react to reply.
35-1,2,3,4 Determine what information to include in call for fire.

11E: 9-1,2,3,4,5,6,7,8 Select hand signals, flag signals, light signals.

C. Recognition of equipment

11B-C: 13-1,2,3,4,5 Identify vehicles, light weapons, missile from pictures.

11E: 1-1 through 2-10 Identify aircraft from slides.
3-1 through 4-10 Identify vehicles and weapons from slides.

D. Decision making

11B: 6-1,2 Select method for crossing barbed wire.
9-1,2 Select cover, concealment.
28-1 Select safest method to destroy mines.

11B-C: 1-1 Decide on how to stop bleeding.
2-1,2,3,4 Select protection from nuclear blast, chemical spray fallout.
7-4 Decide what to do when team leader moves.
8-1,2,3,4,5 React to flares.

11E: 15-1,2 Select temporary tank firing positions.

II. Procedural Segments

A. Basics

11B: 22-1 Purpose of firing stakes.

11B-C: 3-1 Recognize symptoms of exposure to nerve agent.
20-1 Probable cause, M16A1 magazine fails to lock.
21-1 Recognize probable error from rifle shot pattern.
23-3 Probable cause, M203 cartridge fails to extract.
23-4 Maximum range, M203.
29-9 Expected result in check of .45 pistol.

11C: 9-3 What determines slope on parapet for mortar position?

- 11E: 7-1 Recognize symptoms, before administering atropine.
8-2 Expected time, fire extinguisher to stop fuel.
14-4 Recognize when taillight looks too close.

B. Selection of procedural steps

1. Determination of subtasks
2. mechanical

- 11B: 10-1,2,9 Decide on priority tasks for defensive position, and whether to make range card.
22-3,4,5 Aline aiming and firing stakes, mark off limits and likely approaches.
28-3,5,6 Decide on methods for destroying mines in place.
32-1 How should you estimate range of tank for LAW?

11B-C: 23-2 Decide how to adjust fire, range, M203.

- 11C: 9-1 Decide on first thing to do in constructing mortar position.
25-2,3,4 Decide on operations with M2 aiming circle when laying mortar for direction.
31-7 Decide what to do when mortar obstructed by tree.
32-2,6 In preparing mortar ammo for firing, decide what to do first, and how to correct misadjustment.
34-2,3,5,6 Decide what to do after mortar "MISFIRE."
35-2 In laying mortar, decide what to do after leveling.

- 11E: 8-1,3 In M60A1, decide what to do in case of fires.
11-1,3 Decide on loader subtasks in prepare-to-fire checks.
12-1 Decide what to do if generator indicator points to "right red."
13-1,2,3,4 Decide what to do in starting and stopping M60A1.
14-1,2,3 Decide how to react in driving situations.
16-1,2 Decide on field-expedient methods of recovering tanks.
18-1,2 Decide on firing technique, M85 machinegun.
21-6,7 Decide what to do with azimuth indicator, elevation when making range card.
22-3 Decide on method for reoccupying night firing position.
23-2,3 Decide what gunner should do during prepare-to-fire checks (2 situations specified).
28-2 After zeroing main gun, decide what to do with scales.
29-1 Decide what gunner should do if main gun repeatedly fails to fire.
30-1,2,3 Decide on gunner actions in firing from a range card.
-

b. bodily

11B-C: 1-3,5,6 Decide what to do with wounded man if his heart stops, if you get tired doing artificial respiration, and how to reduce heart strain.

3-3 Decide how to mark casualty who has had injection.

11E: 5-1,2,3 Decide on sequence to decontaminate skin, and where not to use solution.

6-1,2,3 Select steps in artificial respiration.

7-4 After atropine injection, decide what to do if symptoms persist.

2. Selection of materials

11B: 24-5,6 Select solutions to clean, lubricate M203.

25-1,2 Select hand grenades.

33-3,4, Decide what to use to clean metal surfaces, eyeshield on AN/PVS-2.

11B-C: 19-1,2,3,4,5 Indicate what is needed for an ESC inspection.

29-2,3 Select solutions to clean, lubricate .45 pistol.

11C: 17-1 Select ammo for screening mission.

32-1 Select mortar ammo.

11E: 28-3 Select ammo, range to zero main gun.

3. Manipulation

11B: 24-1,2,3 Select actions in disassembly of M203.

31-1 Select immediate action for LAW.

11B-C: 17-1,3,6 Select manual steps in operating field telephones.

20-24 Select actions on M16A1 for immediate action and for clearing weapon.

23-5,6,7 Select steps in immediate action on M203.

29-1 Decide what part to remove next, .45 pistol.

11C: 32-4,5 Decide what to do with pull wire on mortar ammo.

11E: 11-2 Decide on loader's action in checking firing switches.

18-2 Select switches to turn on to fire M85.

4. Maintenance

a. Inspection

11B-C: 4-1,3 Check facemask carrier for mildew, rips, holes, torn straps.

11C: 33-2 How should mortar shock absorber clevis be checked?

11E: 12-2,3,4 Select what to look for in checking air cleaner blower motors, filter element and box, suspension system.

b. Removal

11B-C: 4-5 Decide whether to remove voicemitter.

c. Surface treatment

11B: 33-2 Select method for cleaning lens on nightsight.

11B-C: 4-2,4,6,7 Select methods for cleaning parts of facemask.

29-4,5,6,7 Decide what is OK in maintaining ammo.

11C: 33-1,3,4,5,6,7 Decide whether to clean, paint parts of mortar.

5. Interpersonal or administrative action

11B: 12-1,2,3,4,5,6,7,8 Decide how to handle prisoners in various situations.

24-7 Decide what to do with corroded ammo for M203.

33-1 Decide what to do about scratch on lens of night vision sight.

11B-C: 1-2 Decide what to do when wounded man is scared.

17-2 Decide how to get buzzer on field telephone.

29-8 Decide whether to turn in defective cartridges.

11C: 33-8 Decide whether to report water in mortar traverse.

11E: 17-1,2,3,4,5 Decide how to handle prisoners in specific situations.

C. Characteristics of procedural steps

1. Alinement

a. Pictorial

11B: 30-1,2,3,4 From the drawings of 90mm RCLR sight picture, state range, leads, and correct BOT aiming.

32-2,3,4 Select correct LAW sight picture for aiming under stated conditions.

34-1 From illustrated shot group, what sight correction is needed on M16A1?

- 11B-C: 21-2 From illustrated shot group, select sight adjustment on M16A1.
23-1 Select correct sight picture for M203, under stated conditions.
- 11E: 21-4,5,8,9 What is reading (from illustrations) of deflections, quadrant elevations?
22-1 Select correct sight picture for reoccupying position.
24-1,2,4 Select correct sight pictures under specified conditions.
25-2,3 Select correct sight pictures under specified conditions, battlesight.
26-1,2 Select correct sight pictures for subsequent fire command, and when M32 is inoperative.
27-1,2,3,4 Select correct sight pictures for BOT.
28-1 Select correct sight picture in zeroing main gun.

b. Descriptive

- 11B: 26-1 To fire Claymore mine, should safety bail be in ARMED position?
- 11C: 24-1,3 In direct alignment of mortar, where should cross-arms, crossline be pointed?
26-3 In mounting mortar, what deflection should be indexed?
30-2,3,5 In boresighting mortar, what is the deflection and elevation, and with what should sight be aligned?
32-3 On mortar ammo, should slot be aligned with "SQ" index?
35-3 With what should mortar sight be aligned?
- 11E: 23-1 In prepare-to-fire checks, what should oil pressure drop to?
24-3 What is aim-off under stated conditions?
25-1,2 Under stated conditions of battlesight, what does gunner index into computer, and what is initial lead?
26-3 What is standard range change?

2. Process characteristics

a. quantitative
(1) optimal

- 11B: 27-7 Determine intervals to probe for mines.
- 11B-C: 1-4 Determine frequency of heart massage and artificial respiration.
- 11C: 26-4 Determine number of compasses to use in laying mortar.
- 11E: 6-4 Breathing rate for artificial respiration.
-

(2) limits (maximum or minimum)

- 11B: 25-3 What is maximum grenade "cook-off?"
- 11B-C: 3-2 What is maximum times to administer atropine?
7-1 What is maximum exposure using rush to cross open area?
- 11C: 25-6 What is maximum difference in azimuth between mortar and A/C?
26-2 What is maximum error, directional stakes?
30-1,6 In boresighting, what is minimum distance of distant aiming point, and maximum traverse?
- 11E: 7-2,3 What is maximum number of injections, and minimum seconds for application?
29-2,3 What is minimum wait after misfire, to open breech, if gun is cold, hot?

b. qualitative

- 11B: 6-3,4,5 In going over a wall (combat), should you use buddy system, smoke, upright position?
11-1,2,3 In a camouflaged position, where should you exit, put extra dirt, get vegetation?
24-4 Who should replace M203 sight leaf?
25-4,5,6 In handling grenades, should you hold safety lever down with thumb, hang by pull pin, defuse duds?
26-2,3 When should Claymore mines be detonated?
27-3,4,5,6 When probing for magnetic-influence mines, should you keep rifle, remove helmet, roll up sleeves, push straight down?
28-4 Should you always treat a mine as if booby-trapped?
- 11B-C: 7-2 How should you rush?
7-3 How should you move in gully?
19-6 Where do you look to find URGENT MWOs?
- 11C: 25-5 Which scale do you read deflection from?
31-3 How tight should locking nut on bipod be?
34-1 On mortar, who should announce "MISFIRE?"
34-4 In removing misfire, how far should you tilt barrel?

3. Product characteristics

- 11B: 5-1,2 Select pictures that show the best camouflage for face, helmet.
10-3,4,5,6,7,8 Should defensive position have 2' grenade sump, elbow holes, firing stakes, camouflage, level bottom?
15-1,2,3,4,5 Where do you place trip flare, trip wire, anchor, ratchet? Should you use camouflage?
-

22-2,6 Should aiming and firing stakes be loose? How high should fires be?
28-2 To destroy mine with hand placed charges, how much explosive should you use?

- 11C: 9-2 What is maximum for parapet?
26-1 Where should you put mortar base stake?
30-4 What is distance from mortar to boresight box?
31-1,2,4,5,6 On mortar what do you look for in checking socket cap, clevis lock pin, bipod chain, mask clearance, overhead clearance?
- 11E: 10-1,2,3 Select drawing showing correct intercom hookup under stated conditions.
22-2 What should be deflection of aiming stakes?

reader should refer to Table 3-2 for the complete list of test items for each category as it is discussed. Generally, there is no equipment involved that cannot be brought into the test situation; one exception is the M16 plotting board, which was classified as a paperwork task because of the nature of the process, even though the board itself is too cumbersome to provide with the test. Most of these questions are from the 11C2 test, reflecting the relatively heavy loading on computational skills in that MOS.

Deduction differs from decision making by involving much longer chains of responses, and a better-defined initial situation. With deduction, guessing is rarely successful, and several intermediate steps are required. But similar processes are involved, so confusing the two is not apt to have practical consequences. Recognition of equipment may involve a sequence of reasoning, but that is not required by the standards. Recognition also involves a possibly ambiguous stimulus situation, the defining of which is the essence of the task.

The performance required in deduction test items closely resembles that required on the job, and it follows the ideal model of WC items, so WC seems eminently suitable for this kind of skill. HOC (Hands-On Component) could also serve the purpose, but is simply unnecessary and cumbersome in most cases. However, some refinements of item format are possible to minimize extraneous reading, and these will be discussed in Chapter 4. Even in the present format, these WC items have high content validity on the whole.

One kind of deduction that is less desirable is "Recognition of steps" (I A2, Table 3-1) instead of "Performance" (I A1) of the task. In particular, recognizing the steps in preparing the M16 plotting board is distinctly different from actually doing it (11C2, 27-1 through 8), and even experienced people may not think of it in those terms. If such items could require something closer to task performance, it would be preferable.

Communication, signals. Tasks of this category involve interpretation of a standard set of signals, and sometimes sending the correct signals for the situation. WC items for this kind of task generally involve matching signal and meaning.

When the task involves sending of signals, the recognition tests may not be fully adequate. In particular, tasks involving spoken responses (e.g., sending a radio message), actually practicing the responses is likely to be needed to develop fluency. In such cases training to a WC test would not be expected to produce the fluency desirable in actual communication. This kind of item seems all right as far as it goes; HOC could do a more complete job of testing, and may be worth the extra trouble it would take. Since communication is generally a part of the operations, it may be efficient to test some of the skills in the context of another HOC task.

Recognition of equipment. For this category, WC is as appropriate as any kind of testing, given the limitations of simulating equipment with pictures or slides. There is need for thorough analysis in development of the imagery and program so that combat-relevant cues are presented and no other clues. Selection of equipment also should involve tactical analysis. The reasoning process in recognizing equipment is generally much more direct than with deduction.

Decision making. "Decision making" items involve (1) a rather simplified situational description, (2) the application of decision rules that authorities have established as doctrine, and (3) selection of a course of action that differs qualitatively from the other

alternatives presented. The "decision" may be separated from the larger situation in which it occurs without substantial change. This is a rather specialized sense of the word "decision," which sometimes is used loosely to cover almost any act. Note that many simpler kinds of "decisions" would already have been sorted out into the previously considered categories. Remember the practical advantages of considering brief, circumscribed choice performance as a separate task. If a particular task could be classified either as deduction or decision making, then the sort probably makes little difference. These items generally involve individual tactical responses on the battlefield. All 31 of these items were part of tasks classified as "Battlefield operations."

WC seems the only feasible way to test such skills. HOC testing would be very expensive and time consuming. For instance, in "React to flares," there would have to be various combinations of overhead and ground flares, under direct fire or not, with a variety of terrain. There may be some justifiable reservations about the oversimplification of WC, but the alternatives are most unattractive. Certainly, the skills involved are too critical for the combat mission to warrant leaving them untested.

Procedures

The remaining categories involve testing only segments of procedures that are implied by the problem situation. It is perhaps surprising how seldom these test items involve selecting a particular mechanical response, such as pushing a switch, from a list of such responses. More often the soldier was required to choose among response units that were less detailed than particular movements, or to distinguish the characteristics of correct responses, rather than the responses themselves.

Basics. This category includes items that require discrimination of underlying mechanisms (or "causes") that presumably imply appropriate action, but do not state the performance explicitly. For example, the 11B and 11C soldiers were asked the probable cause if an M203 cartridge failed to eject. The danger, of course, is to test for "theory" that is unrelated to performance, but the WCs that were analyzed avoided that shortcoming. Such avoidance should be continued. It is generally difficult to arrange an HOC unit to test the same processes, e.g., imagine the difficulty of finding out with HOC whether a person knows the maximum range of a weapon, compared with simply asking in WC what is the correct figure.

Some items testing basics had questionable content validity, but not on the basis of relevance for performance. The questionable items involved recognition of a person's symptom pattern with chemical poisoning. It was dubious whether a pattern was correct if one or two of the classic symptoms, as listed in the Soldier's Manual, was absent, or if another symptom was added. The realism of symptom description was also suspect.

It is concluded that basics is a mixed category of items, which may or may not have high content validity. Some likely invalidating characteristics are (1) questionable realism of cues, and (2) dubious relevance for performance.

Selecting Steps

The next group of categories involves the selection of a procedural step, which may vary considerably in level of detail. The common denominator is that such items involve choice among different actions, rather than among different characteristics of the same action, which characterizes the next group of categories. For instance, if the choice were between turning a dial and pushing a lever, it would be a selection of a step; but if the choice were between various settings of the same dial, it would be a characteristic of the step.

Subtasks. In "Determination of subtasks," the person is asked to select a course of action that is more specific than the whole task, but more general than the movement of a particular part, which would be classified under "Manipulation" (see below). Since the items describe general rather than detailed actions, they may be abstract or even vague. There is a tendency to substitute description for performance. People who criticize WC testing often are thinking of questions of this sort.

The "mechanical" kind of subtask is most directly related to the primary mission of the MOS. Often the choice is between different methods for accomplishing a particular goal (e.g., methods for destroying a mine in place) which may involve a compound statement (e.g., "partially clear fields of fire and dig a hasty hole for minimum protection").

Often the choice is between "do" and "not do," and that is an extreme form of overprompting. For instance, in constructing an individual position, who could argue with the desirability of alining azimuths and firing stakes, or of marking off limits and likely approaches? There is no reason to suppose that an affirmative answer would imply remembering to do it, or knowing how to do it. Such items can only discriminate when there is a possibility of the action violating some prohibition.

Another common form of item in this class is deciding what to do "first," or "next." This form also overprompts, but not so severely as the "do/not do" form of item. There is a tendency to consider the alternatives before reasoning out a response, which is contrary to the model of WC items. In the process of comparing each alternative with every other one, inconspicuous flaws may be overlooked (e.g., "clear fields of fire" may be equated with "partially clear fields of fire").

Some items of this kind, however, are relatively specific (e.g., how to estimate range with LAW, or how to adjust fire with the M203). Such items resemble manipulation items in their specificity, but differ in focusing on the task cues rather than responses. Such items generally have fairly high content validity. Other items resemble decision making tasks (e.g., deciding on field expedient methods for recovering tanks) and have comparably high content validity.

This kind of item may also present difficulties for HOC testing. The performances are generally time consuming and the conditions are difficult to simulate. Some of the items also involve contingencies that occur only occasionally.

The "bodily" variety of subtasks involves similar difficulties for WC, plus the difficulties in describing actions on a body. The actions tend to involve details of technique that are better acted out, both in training and in testing, than described

abstractly. HOC is often an improvement for testing, but the skills are not directly critical to the soldier's combat mission, so testing them may not be considered worth the effort.

Selection of materials. Items of this sort are generally nearly equivalent to the corresponding steps in task performance. Most of these involve either selecting solutions to clean or lubricate, or selection of ammunition. There are often basic rules involved like those in decision making, and similar processes are involved, except the choices are even better defined (i.e., materials). WC testing is appropriate. HOC might also test this kind of thing, but would not be worth the trouble; also, the range of choice in HOC tends to be limited for practical reasons (e.g., one particular kind of ammunition is usually the only choice provided).

Manipulation. "Manipulation" items involve choice among specific manual responses (e.g., which switches to turn on). These responses tend to involve a minimum of reasoning, and representation with words is questionable. HOC is generally more appropriate and feasible (e.g., disassembly of the M203).

Maintenance. These items include inspection, removal, or treating a surface. (A related kind of item, "selection of materials," has already been considered as a separate category, so such items are specifically excluded.) Inspection items tend to be obvious when they ask whether to make a check, but may be valid when they ask how a check should be conducted. Items concerning treatment of surfaces generally involve decision rules on what is prescribed and what is prohibited and, therefore, resemble decision making items. The tasks tend to be time consuming on the job and not particularly critical, so WC is generally the only feasible testing method.

Interpersonal or administrative action. "Interpersonal or administrative action" may not always be considered a response, but clearly such decisions are an important part of Army operations. The "actions" include "allowing," "requesting," "reporting condition of," and "turn in." Rules of conduct are involved, and the items are much like decision making, both in training and testing methods. WC is generally the only feasible way to test these actions.

Characteristics of Procedural Steps

The remaining categories involve determination of the characteristics of actions, rather than determining the kind of action needed. It is perhaps surprising how many items fall in these categories, since the response alternatives are not what one generally thinks of as different actions. The questions generally are easy to write and to understand, and usually are content-valid. However, they tend to be narrow in scope, representing only one aspect of a response, so ability on such items may be considered a necessary, but not a sufficient condition for correct responding.

Alinement. The first category involves "Alinement" of some features of the task. Most commonly the alinement is something to achieve by movement of controls or parts, but sometimes it is a display to be read.

Often the alinement items are "pictorial"; that is, a choice involving pictures as an essential stimulus element, and not just "nice-to-have" illustrations. Most commonly the

pictures are sight pictures that are desired at the time of firing. If the person cannot select the correct sight picture, he will not hit the target consistently; but if he knows the correct alignment, he still needs other skills to hit. Therefore, this sort of WC item appears to have content validity, even though they are limited in scope.

It is very difficult with HOC to test this kind of thing. One way is to actually fire, but that is very expensive. Also, if the soldier misses, there is no easy way of knowing whether he did not know where to aim or whether he merely lacked manual skill.

Similar considerations apply when the alignment is "Descriptive." One should also determine, however, whether the alignment should be illustrated, or whether words are sufficient.

Process characteristics. These items require specification of the process of performance (as opposed to the end product). Questions of this sort ask how, who, when, where, or how many times the action is to be performed, not what the action is.

Logically, alignment would be a subclass of process characteristics because it specifies something about the response. However, the prominence of alignment items seemed to warrant a separate category.

Process items may be either quantitative or qualitative. The quantitative items may specify the "optimal" (e.g., best interval, rate, number) or the limits, in terms of maximum or minimum allowable. Quantitative items present difficulties in HOC testing because the examiner may find it impossible to infer whether the observed performance was accidental or intentional. That is particularly true of "limits" items (e.g., how can one infer that a person avoids exceeding the maximum range without asking him explicitly?).

The quantitative questions have another advantage for WC testing: the answer choices are all plausible, they do not usually overprompt, and they are easily understood. In those respects they conform to the model of WC items.

The qualitative variety of process items has similar advantages, except that plausible alternatives may be harder to generate. Sometimes there is an attempt to disguise and unattractive choice with a good reason (e.g., "standing upright in battle so that you can observe the enemy"), but that ploy may be transparent to most soldiers.

Product characteristics. The last category includes items that specify some aspect of the product that the action is to produce. A judge of such performance would not need to watch the soldier perform, but could get criterion information by examining the result. Such WC items have advantages comparable to those of process items. In addition, criticality of the product may suggest that pictures could be used to increase realism and save time. (It is critical, however, that any pictures should clearly illustrate the characteristics involved.)

Relating Item Categories and Task Categories

All items were classified both by type of question and by type of task in which it occurred (Table 3-3). That matrix showed that each kind of item tended to be used for particular classes of tasks, but that the association is far from complete.

Generally, deduction items are parts of "Paperwork" or other "Mental" tasks (Table 3-3). Significant exceptions were corrections for a mortar, which were computational in nature, but part of a task of engaging the enemy. Similarly, five other computational items involved data for setting up a mortar, which was a procedural task.

Questions about communication and signals tended to be from tasks classified as "coding, conventions" (17 items) but a few were embedded in "call for fire" operations (8 items). All 50 equipment recognition items were associated with the corresponding task category. "Decision making" usually involved tactical operations on the battlefield.

The "Procedural Segment" items were distributed over several task categories, except they tended not to be a part of "Paperwork" or "Other Mental Work." One exception was the set of questions about what is needed for an Equipment Serviceability Check (5 items repeated in 11B2 and 11C2), and that was considered a mental operation.

Table 3-3
COMMONALITY MATRIX*

Kinds of Tasks		Kinds of Items												TOTALS								
		I. Separable Processes			II. Procedural Segments			III. Decision making			IV. Manipulation											
		A. Deduction	B. Basics	C. Procedural steps	D. Mech subtasks	E. Select materials	F. Maintenance	G. Admin.	H. Steps	I. Char. alignment	J. Process char	K. Product char	L. Interpers. char.									
I	Paperwork.....	25	8	.....1) performance	.....2) recognition	.....B. Commo, signals	.....C. Recog. of equip.	.....D. Decision making	.....II. Procedural Segments	.....A. Basics	.....B. Procedural steps	.....1) mech subtasks	.....2) bodily subtasks	.....3) select materials	.....4) manipulation	.....5) maintenance	.....6) interpers admin.	.....C. Char of steps	.....1) alignment	.....2) process char	.....3) product char	33
II	Mental wk (other)																					23
A.	Operations.....	2	9																			2
B.	Elements																					21
1.	calculate.....																					50
2.	coding, conventions....	4		17																		27
III	Identify equipment.....					50																50
IV	Target engagement																					
A.	Aim w/st pict.....							2	3													22
B.	Engage w/o st pict																					27
1.	operate.....	9																				25
2.	call for fire.....	11	8																			20
V.	Procedure, machine																					
A.	Preparation																					
1.	aline.....	5						2	7	1												37
2.	inspect, adjust.....								7	1	3	3										22
B.	Operate equipment																					
1.	drive, start.....							1	7													8
2.	switch, hookup.....																					17
3.	emergency.....							5	7		2	6	1	3	2							30
C.	Maintain.....							2		6	4	30	4									47
VI	Battlefield ops																					
A.	Tactical.....							26														35
B.	Procedural																					
1.	construct.....								2	7												28
2.	survival.....							2	3	15											29	
3.	other.....							3	5												20	
VII	Interpersonal rules.....																					8
TOTALS		58	17	25	50	31	17	49	15	23	24	14	22	45	44	28	482					

*The entries indicate number of test questions in common between task categories and item categories, including all items from 11B2, 11C2, 11E2 WGs (track 1 only).

Chapter 4

TESTING AND TRAINING METHODS IN THE SQT SYSTEM

The taxonomies of tasks and items were developed as part of a program of research on the Skill Qualification Testing (SQT) system. Other developments include refinements in test items, training materials, and unit training strategies, which will be presented and discussed in this chapter. The particular issues to be addressed were derived from a general model of the SQT system, most of which is implicit in SQT publications and the performance-oriented model.

COMPONENTS OF THE SQT SYSTEM

The SQT system is an annual individual training cycle to prepare those who will take the tests that year. The major subsystems are as follows:

- I. Soldier's Manual (SM).
- II. SQT Requirements Alert Notice (SRAN) and Soldier's Notice (SN).
- III. Training Activities
 - A. Individual study
 - B. Unit training
 - 1. General practice, targeted to skills
 - 2. Diagnostic testing, status summaries
 - 3. Specific practice, targeted to particular tasks and people.
- IV. Skill Qualification Testing.

The Soldier's Manual (SM) is supposed to contain sufficient information to enable a soldier to do each task in the MOS (Military Occupational Specialty), insofar as feasible. Occasionally the SM may refer (explicitly) to another common job reference, when the needed information is too bulky to duplicate in the SM.

The SRAN and the SN isolate the specific skills to be trained. The SRAN is sent to units as soon as the proponent agencies decide which tasks will be tested, and later the SN tells the individual soldier (and unit) what parts will be tested, and how.

The training activities involve a shared responsibility between individual study and unit training. Generally speaking, the individual is responsible for knowing how to do the task, and the unit is responsible for providing an opportunity for practice, although the delineation of responsibility is not distinct. The individual's study becomes increasingly specific and intense through a series of events: (1) receipt of the SM and revisions, (2) task listing in SRAN, (3) description of testing methods in SN, and (4) discovery of deficiencies during unit training activities. Unit training activities continue throughout the year, especially in the form of concurrent training, based upon information from the SM and other publications. The training becomes more task-specific as SRANs and SNs are received. In an ideal program, diagnostic testing would be administered to every soldier to determine whether they have mastered each of the tasks targeted by SRANs and SNs. The results of diagnostic testing would be summarized for company and battalion staff so they could manage resources, allocate responsibility, and assure that

every soldier has a high probability of "GO" on each SQT scoring unit. Diagnostic testing would be repeated on specific tasks for specific individuals, until mastery is demonstrated.

The Skill Qualification Testing assesses the skills of each soldier on each of the targeted tasks. The testing should simulate job performance and standards, but should not require extraneous reading. It is sometimes argued that units should use the results of SQT to guide subsequent training activities, but they have little incentive to do so. By the next testing many of the commanders, staff and troops will have transferred, and others will forget part of what they might have learned. Until there are changes in the incentive systems, the SQT will continue to function like a final exam (i.e., summative testing), and diagnostic testing before the SQT will be needed for the formative testing function.

TESTING METHODS

In Chapter 3, high content validity was found for items classified as deduction. Content validity may be compromised, however, if the items require difficult reading that is not part of the task.

Eliminating Extraneous Reading

Compare the test item shown in Figure 4-1 with the corresponding lean version (Figure 4-2). The revision not only has fewer words, but also requires fewer operations of the reader. The original directs the reader's attention back and forth between the question, the illustration, the answer choices, and the answer sheet. The revision guides the reader's attention directly from the question to the illustration, and then to the answer sheet. There is no need to repeat the answer choices because they are indicated directly on the illustration.

It was assumed in the revision that the same format would be used in the SN or during practice in diagnostic testing. Otherwise, the soldier might not notice that "entries" is plural, and that more than one answer is required. The issue of multiple responses, and many similar issues, could be resolved if one could assume the same format would be used in diagnostic testing during training. As a result, the items could be much simpler and confusion would be minimal.

A Response Series Within a Problem

A more complex example of lean item format is given in Figure 4-3. Answers are given in Appendix A. It was developed for the M16 plotting board, which will be tested in the 1980 HOC (Hands-On Component). The simplification depends upon integration of answer choices in the illustrations. The first answer involves alinement of the azimuth disk, and is similar to "pictorial alinement" items in the tests, which were distinguished by a high degree of content validity. The rest of the items involve using a table and making entries in a standard form. Getting the correct answers also depends upon knowing where to get the deflection (from the vernier scale on the correct alinement) and how to read it.

113. (Refer to figure 12-2.) Which entries were placed on this DA Form 2408-14 (Uncorrected Fault Record) incorrectly? (More than one answer is required.)

 - A. tow hooks missing
 - B. lock, tow pintle, missing
 - C. MMO 9-2350-215-30/34 past due
 - D. IR power cable (driver) broken
 - E. external fire extinguisher seal broken
 - F. right track loose

Figure 12-2.

GO TO QUESTION 121, UNIT 13.

Figure 4-1. Format example from 1977 test, 11E2 (track 3).
(Content modified for test security)

- 113. Which entries are wrong?**

TANK, COMBO T, FT		M600Z	Serial Number 9C6804		
STATUS	ITEM #	DATE ISSUED FOR USE ON	DATE ISSUED	DATE APPROVED	DATE ISSUED
A.	X TONY HODGES MISSING	2011-001 2010-00-07-100	12 Jun 75	12 Jun 75	12 Jun 75
B.	X LOCK, TOW PINTLE MISSING	2011-002	12 Jun 75	12 Jun 75	12 Jun 75
C.	X M10-9-2350-25-34/34 M10 PINS	2010-0007-000 2010-0007-000	12 Jun 75	12 Jun 75	12 Jun 75
D.	/ JR POWER CABLE (WIRE) BROKEN	2010-00-000-100	12 Jun 75	12 Jun 75	12 Jun 75
E.	- EXTERNAL FIRE EXTINGUISHER				
F.	- SEAL BROKEN		12 Jun 75		
G.	/ RIGHT TRACK LOOSE		12 Jun 75		
H.					
I.					
J.					
K.					
L.					
M.					
N.					
O.					
P.					
Q.					
R.					
S.					
T.					
U.					
V.					
W.					
X.					
Y.					
Z.					

Figure 4-2. Lean version of example from Figure 4-1.

47. Direction of fire is 2753. How should you aline the azimuth disk in Panel 1?

PANEL 1.

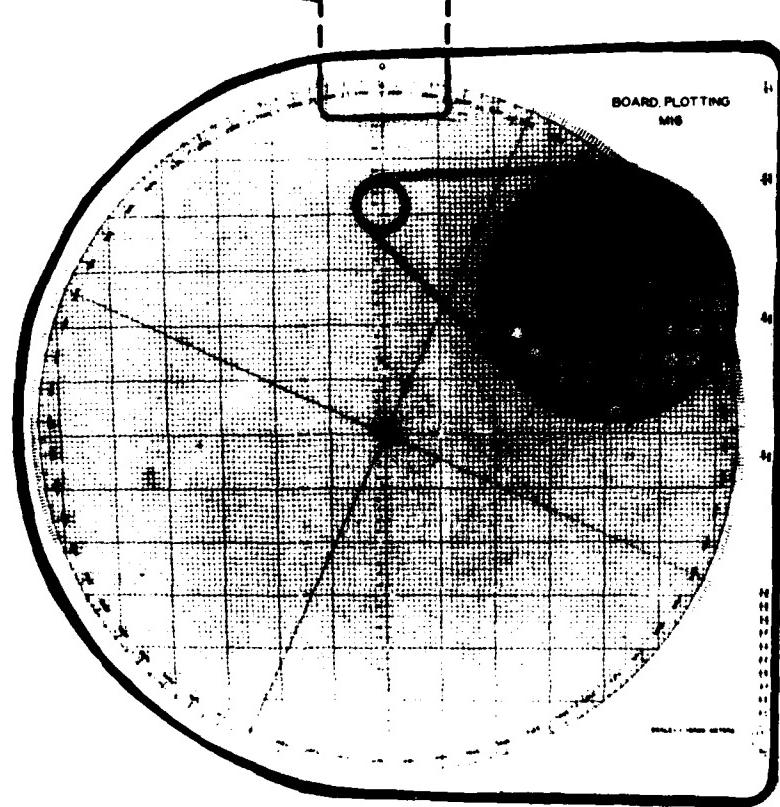
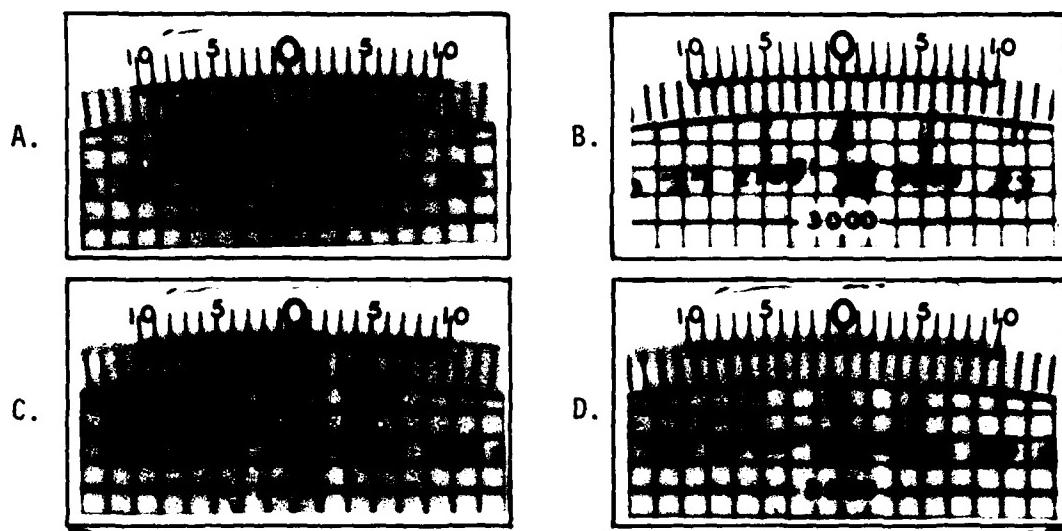


Figure 4-3. Picture-test example: M16 plotting board.

Questions 48-51. Select correct entries for computer record, below, using data from the previous question:

48. A. 2807 49. A. 21
 B. 2803 B. 2100
 C. 2797 C. 2000
 D. 2792 D. 2200

abridged
firing table

RANGE m	ELEV MILS	CMD	ELEV MILS	CMD
1900	1160	4	963	3
1925	1152	4	943	3
1950	1144	4	919	3
1975	1136	4	891	3
2000	1127	4	854	3
2025	1119	4		
2050	1110	4		
2075	1101	4		
2100	1091	4	1205	5
2125	1082	4	1199	5
2150	1072	4	1193	5
2175	1061	4	1187	5
2200	1051	4	1181	5
2225	1040	4	1176	5
2250	1028	4	1164	5
2275	1017	4	1161	5
2300	1006	4	1154	5
2325	991	4	1147	5
2350	977	4	1141	5
2375	962	4	1133	5
2400	946	4	1126	5
2425	926	4	1119	5
2450	902	4	1112	5
2475	884	4	1106	5
2500	854	4	1096	5
2525	822	4	1084	5
2550	797	4	1080	5
2575	772	4	1072	5
2600			1063	5
2625	1163	6	1055	5
2650	1150	6	1046	5
2675	1132	6	1036	5
2700	1116	6	1027	5
2725	1100	6	1017	5
2750	1136	6	1006	5
2775	1120	6	995	5
2800	1121	6	984	5

COMPUTER'S RECORD				
For use of this form, see FM 23-91, the primary agency is TRADOC.				
ORG	A60 1/66	DATE	19 MAR.	TIME
ORG	A60 1/66	DATE	19 MAR.	TIME
VI	CHG RG CORR	CHG DEPL	CHG RG	
DEPL CORR		ANGLE T	CHG	
CALL - FOR - FIRE	FDC ORDER	INITIAL FIRE COMMAND	RDS EXP	
	MORT TO FFE	MORT TO FOLLOW		
	MORT TO ADJ	SHELL & FUZE		
	METH OF ADJ	MORT TO FIRE		
	BASIS FOR CORR	METHOD OF FIRE		
	SHELF CORR	DEFLECTION		
	SHELL & FUZE	CHARGE		
	*****	*****		
	METHOD OF FFE	TIME SETTING		
	RG LATERAL SPREAD	ELEVATION		
	ZONE			
	TIME OF OPENING FIRE			
OBSERVER CORR	CHART DATA	SUBSEQUENT COMMANDS		
	(TIME)	CHG MORT	SAME	
RE-SHOTING				

DA FORM 2399
1 OCT 77

REPLACES DA FORM 2399, 1 JUL 68 WHICH IS OBSOLETE.

50. A. 3
 B. 4
 C. 5
 D. 6

51. A. 1127
 B. 1051
 C. 1091
 D. 1205

The M16 picture test example illustrates a degree of task continuity that is uncommon in WC scoring units. That continuity allows for greater realism with fewer words, and a more nearly complete sampling of task responses. One of the major limitations of WC for procedural items was the severe segmenting of the response chain, with many segments remaining untested.

The answer to item 48 depends upon getting the previous item correct, so it might be criticized on the grounds of "item dependency." However, the dependency is one that is intrinsic to the task, and not an artifact of the testing method. The alternative would be to overprompt by giving the deflection, or by focusing attention on a particular scale to be read.

Serial Responses in Mechanical Systems

The classification of WC items revealed a larger number of manual responses that could be tested validly with multiple choice. The responses commonly involved weapons or other machines. It would be desirable to integrate those responses in complete problems. The unresolved issue was whether such test responses could be integrated in complete problems. An example was developed for the reciprocal lay of the 81mm mortar using the M2 aiming circle (Figure 4-4). Answers are given in Appendix A. That task was chosen because it involves many of the common but difficult responses on the mortar, and because it will be tested in the 1980 HOC.

The soldier, in working each step of the example, finds his response choices in the illustration next to the part he would touch. Spoken response choices are listed at the bottom.

An important advantage of such serial responses is that they are not overprompted. The responses are "coded" by location in the task environment, so the experienced soldier can find them, but the novice cannot. There seems little chance that a novice could correctly guess his way through such problems.

It remains to be seen how much practice (if any) soldiers need to become accustomed to that kind of item. If difficulties do arise, modifications may be needed. One unconventional feature is that the answer codes (A, B, C, D, or E) are not unique to a particular answer, so one cannot reason backwards from answer sheet to response choice. That feature permits the use of a standard five-choice answer sheet. Another unconventional feature is the chaining of responses. Each command is followed by several responses, in sequence. If the soldier forgets one response, he will be out of sequence in that section on the answer sheet, which he will discover before working on the next series of responses.

All of the above sequential examples depend upon a reasonably constant task environment that may be pictured. Although most tasks seem to satisfy that requirement, a few do not. For example, assembly and disassembly of a weapon involve many substantial changes in visual cues present.

The picture-test methods are intended to be used first in diagnostic testing during training, where any difficulties may be worked out. After the item formats and methods are thoroughly tested, they may also be used in the SQT itself. In diagnostic testing, they

Reciprocally lay mortar using M2 aiming circle and place out aiming posts
(Task No: 071-321-3910)

Initial conditions: You are the gunner, and your mortar has been laid on the direction stake with deflection 3200 mils, elevation 1100 mils. A/C operator says, "AIMING POINT THIS INSTRUMENT."



115, 116. What do you do now?

(Think of your first response and find it in Panel 1. Notice whether that response is an A, B, C, D, or E. Then mark that choice on your answer sheet for item 115. Do the same for your second response, item 116).

117-122. A/C operator then says, "NUMBER ONE, DEFLECTION 2305." What do you do next?

(Respond as before, marking items 117-122.)

123-126. A/C operator then says, "NUMBER ONE, DEFLECTION 2303." What do you do then?

127. A/C operator then says, "NUMBER ONE, DEFLECTION 2302." What do you do next?

Figure 4-4. Picture-test example: 81mm mortar.

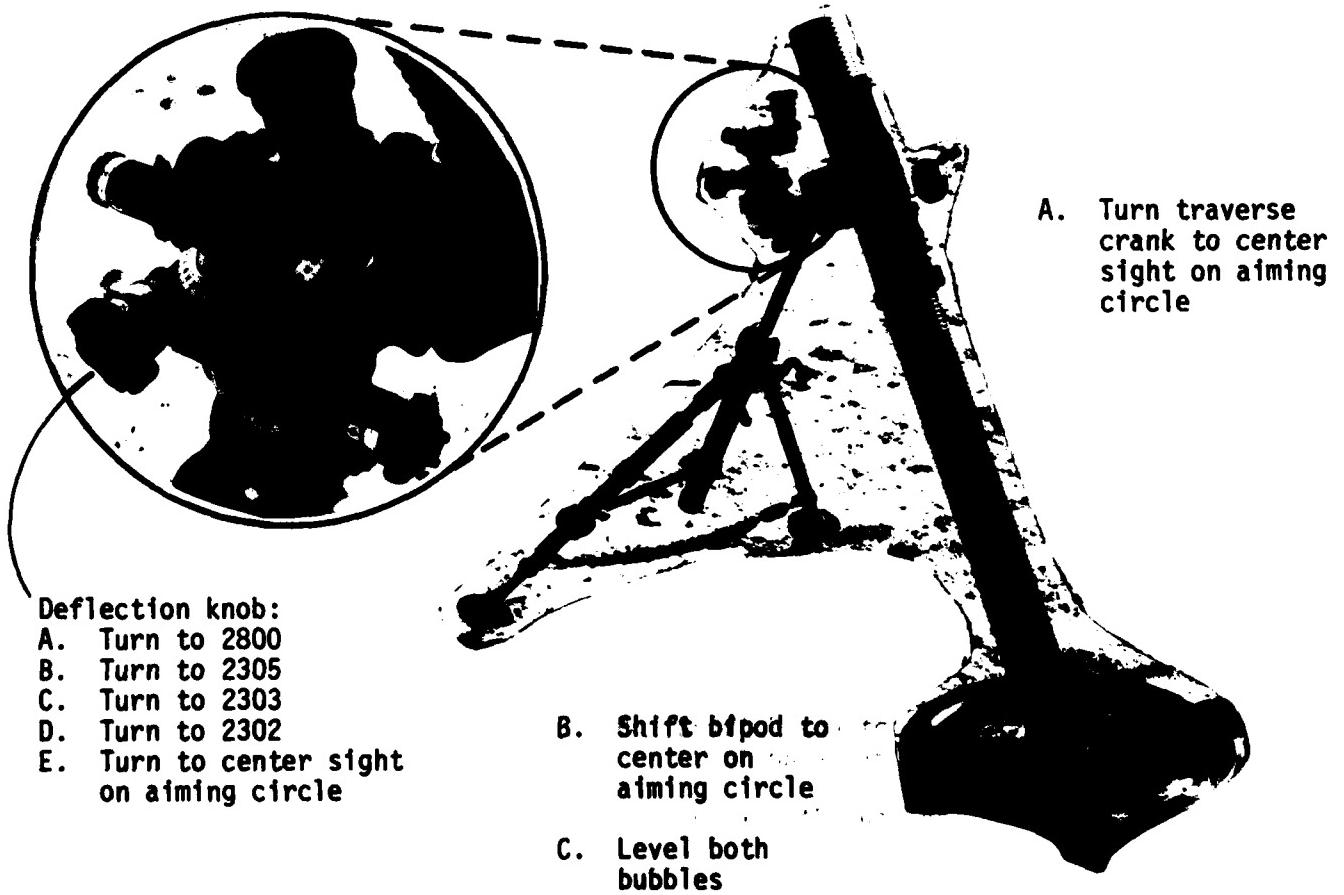
PANEL 1. RESPONSE CHOICES FOR ITEMS 115-127
(continuation of Fig. 4-4)

Spoken response choices:

- A. "AIMING POINT IDENTIFIED"
 - B. "NUMBER ONE, DEFLECTION 2305"
 - C. "NUMBER ONE, DEFLECTION 2303"
 - D. "NUMBER ONE, DEFLECTION 2302"
 - E. "NUMBER ONE, DEFLECTION 2301"
-
- A. "READY FOR RECHECK"
 - B. "NUMBER ONE, ZERO MILS, MORTAR LAID"
 - C. "NUMBER ONE, ONE MIL, MORTAR LAID"
 - D. "NUMBER ONE, TWO MILS, MORTAR LAID"

Manual response choices:

(Look beside the part you would move, to find your choice.)



Deflection knob:

- A. Turn to 2800
- B. Turn to 2305
- C. Turn to 2303
- D. Turn to 2302
- E. Turn to center sight on aiming circle

- B. Shift bipod to center on aiming circle

- C. Level both bubbles

may serve as a handy indicator of skills on HOC tasks, where testing with equipment is cumbersome. For instance, even checking out an M16 plotting board requires a hand receipt, and observing each soldier's performance is time consuming.

TASK INFORMATION

Preparation for SQT depends upon the availability of information on how to do each task, in a form that is clear, concise, and readily accessible. The SM is supposed to provide that, supplemented where necessary by other common references available on the job. Even "live" instruction is dependent upon reliable published job information, if it is to avoid distortion in retelling. For purposes of system design, the operating assumption is that job publications must bear the responsibility for providing sufficient information to do each task.

Defining Specialized Operations

Some of the key elements are exemplified in instructions developed for reciprocally laying the 81mm mortar using the M2 aiming circle, which is included in Appendix B, along with the corresponding section of the SM. Before proceeding with this section, the reader is encouraged to read the original SM instructions, noting any points that seem ambiguous, and then to read the revision, to see whether the ambiguities were resolved, and how.

One essential feature is explicit instructions defining any technical operations or concepts involved in the task. For example, the original says "Gunner places data on sight and re-lays on center of AC's head, and announces 'READY FOR RECHECK'." The word "re-lays" means that (1) the front bipod legs are picked up and moved over, to center the sight picture approximately on the A/C, (2) both bubbles are leveled by adjustments on the bipod legs, and (3) the traverse crank is turned to precisely center the sight picture on the A/C. Also, instead of "places data on sight," the instructions should use the concrete expression "turn the deflection knob to 2315, red scale." Defenders of the original version might argue that anyone around mortars is supposed to know that sort of thing. But there is no indication of where a soldier could get that information. The instructions on that task did not list any prerequisite task, nor was there any glossary. If the information is supposed to come from experience in the field, then the manual is not serving its function. Certainly the sentence or two specifying what to do is not excessive.

Adequacy of Information

The point of the preceding example is that the publication must bear the responsibility for giving instructions sufficient to do the job. From the system viewpoint, that is the most important characteristic of manuals. If information from another task or publication is needed, and it is too bulky to be repeated, then there must be explicit references citing exactly what points are needed. If authors were required to make such explicit reference, then in most cases a simple way to describe the operation could be found and the reference would be unnecessary.

Literalness and Illustrations

The revision also describes the operations more literally, in ways that do not detract from their generality. One way is by using illustrations that depict the working environment, and are clearly interrelated. For instance, the illustration indicates which digits are read from the coarse adjust, and which from the micrometer scale. The illustrations are used to show specific features of the task, and not random aspects of the job environment. In this revision the specific numerical example, deflection 2315, is continued throughout without implying that the number is the general case. Another kind of literalness is using direct quotes throughout, rather than generalities like "Gunner will repeat all commands from the AC operator," which will lead to incorrect responses later in the task.

Inaccessibility of Information

Other problems in getting adequate task information are illustrated by DA Form 2804-14 (Uncorrected Fault Record) which is shown in Figure 4-1. In order to find out what answers were correct, the SM was consulted. The SM said the form was to be filled out in accordance with (IAW) the appropriate operator TM and TM 38-750. Supposing TM 38-750 would cover the general case, that reference was obtained. Entering through the index, a tortuous path eventually led to the applicable criteria. When the average soldier is required to search like that for answers to simple questions, the publications are not fulfilling their responsibility to provide accessible information.

Determining Answers

The problem of a complicated search was confounded with the lack of a determinate solution once the applicable section was found. Various characteristics of valid and invalid entries were specified, but nowhere was there a limited set that constituted the necessary and sufficient conditions for a valid entry. Reading the section leaves one with an uneasy sense of not having closure. Some bad entries can be recognized, but one can never be sure that an entry is valid, because it might contain a flaw that is implied somewhere between the lines or in another section. The subtlety of this phenomenon masks the problems involved. If a soldier is unsure or wrong about an entry, he can always be told that the answer is "obvious" from one or two of the criteria mentioned in TM 38-750.

Presenting Decision Rules

Soldier tasks that are categorized as "decision making" require a particular kind of instructional writing. It is important to present first the basic decision rules simply and clearly, and leave qualifications, minor contingencies, and similar complications until later, after the basic rules are mastered. The danger is confusion about what should be done. For example, in "React to flares," the basic decision rules are: (1) if it is an overhead flare and you are not under direct fire, drop to the ground and freeze; (2) if it is a ground (tripwire) flare or if you are under direct fire, move out expeditiously and seek cover; (3) under no condition do you freeze in a standing position in combat. Later it may be said that "a hissing sound may give you a few seconds warning to find a better

solution," and "if you can't go prone, get as low as possible." But such complications do not change the basic decision, and should not be allowed to confuse the basic issues. These considerations are particularly important because decision making items are so common in WCs, because they usually have a high degree of content validity, and because they are critical to the combat mission.

REFINEMENTS IN THE SQT SYSTEM

Determination of Test Methods

The first step in developing an SQT for a particular year is to decide which new tasks will be tested, and which of the previously tested tasks will be repeated. Then it must be decided whether to test each with WC (now SC) or with HOC. As an aid in that process, the task content may be classified by the task and item taxonomies according to the definitions and examples given in Chapter 3. Then the choice between SC and HOC may be made on the basis of the factors discussed in Chapter 3, which are summarized in Table 4-1.

If WC/SC is selected as the best form of testing, it is desirable to minimize extraneous reading (that which is not a part of the task) and to increase realism. This may be done by picturing the job environment, and by integrating response choices with those pictures. The results may be checked by counting the required number of steps in going from the question to the illustration(s), and to mark the answer sheet. Difficulty in each step may also be considered. "Picture-test" methods were suggested for a chain of related responses within a task. These methods seem particularly applicable when the task environment is fairly constant, such as operations on weapons, machines, or standard forms.

Providing Sufficient Task Information

To prepare for SQT, soldiers need information on each task that is sufficient to support task performance. That information must be clear, concise, complete and readily accessible. The primary responsibility for this lies with the SM. The adequacy of task information for SQT could be assured by changing the process by which test items are developed and reviewed.

Specifying references for test reviewers. It is suggested that developers of test items be required to submit a supplementary document listing explicit references for task information on each item. The references should be sufficiently specific so that the answers could be readily determined. If there are references beyond the SM, the referenced sections should be reproduced and appended. When checking a test, a reviewer would need the SM, but no other references. In some cases, certain skills basic to the MOS might also be referenced (e.g., being able to interpret symbols and format on a schematic). But in almost all cases the references alone should be sufficient.

It may be that test reviewers only have enough time to spotcheck test items. Use of the reference-listing document should save time by eliminating the need to obtain obscure references. Requiring that document should insure that the test developers use only items the soldiers can answer with accessible information.

Table 4-1

CONSIDERATIONS IN DECIDING BETWEEN SC AND HOC FOR
TESTING PARTICULAR RESPONSES

I. Separable Response Processes

	<u>Skill Component</u>	<u>Hands-On Component</u>
A. Deduction		
1. Performance	Excellent; high content validity.	OK, but not worthwhile.
2. Recognition of steps	OK, but try to convert to a performance item.	Not applicable.
B. Communication, signals	OK, but weak in simulating sending component.	Good. May want to incorporate testing in other tasks.
C. Recognition of equipment	Excellent.	Infeasible.
C. Decision Making	Excellent. Be sure situation is described concisely and realistically.	Infeasible.

II. Procedural Segments*

A. Basics	Good, if realistic and relevant for performance.	Not applicable.
B. Selection of procedural steps	Dubious, especially if steps are described in general terms, or if plausible alternatives are not presented. May be valid if subtasks are described specifically.	Generally infeasible if subtasks are vague or time consuming. For specific actions, valid if feasible.
1. Determination of subtasks		
a. mechanical		
b. bodily		
2. Selection of materials	Excellent.	Good, but generally not worthwhile.
3. Manipulation	Usually weak.	Good, and generally feasible.

*Greater realism and efficiency may be achieved by incorporating several items in a larger problem, and that is especially valid for procedural tasks.

Table 4-1 (continued)

	<u>Skill Component</u>	<u>Hands-On Component</u>
4. Maintenance		
a. inspection	Fair. Good if asking how to inspect.	Good.
b. removal	OK.	Good.
c. surface treatment	Fair.	Good.
5. Interpersonal or administrative	Excellent	Infeasible.
C. Characteristics of procedural steps		
1. Alinement		
a. pictorial	Excellent.	Infeasible, generally.
b. descriptive	Good. Consider whether picture is needed.	Infeasible, generally.
2. Process characteristics		
a. quantitative		
1) optimal	Excellent.	Good.
2) limits (max/min)	Excellent.	Limited, because hard to infer from performance.
b. qualitative	Good, if realistic.	Good, if observable and task not overly time consuming.
3. Product characteristics	Good.	Excellent, if feasible.

Revising task information. It is to be expected that the review process will disclose numerous shortcomings in SMs and other references like those discussed above on the mortar and DA Form 2804-14. One way to remedy these is to publish interim changes to the SMs, perhaps as replacement pages if the changes are extensive. These could be distributed along with SNs in preparation for SQT. The changes should also be filed for incorporation in the next edition of the SMs. Experience with the modifications would soon enable SM writers to anticipate the common inadequacies and avoid them.

Criticality of Soldier's Manuals. These suggestions should not be construed as critical of the system of Soldier's Manuals, because quite the contrary is intended. Soldier's Manuals are a bold attempt to sort job information into manageable units (tasks), and to take responsibility for providing information on each task that is clear, concise, and adequate for performance. Shortcomings are bound to appear, so there is need for a systematic method to correct the flaws.

Defining the Scope of SQT

Soldier's Notice. The skills to be tested are defined in specific terms in the SNs. Since 1977, SNs have become larger, and more specific examples of test items are provided. These are seen as advances, especially the specific examples, subject to certain qualifications concerning teaching specific answers. "Teaching the test" is a common concern and a potential problem, but low average test scores indicate that it is not a substantial problem in most MOS.

It seems desirable, in fact, to extend the use of practice problems, giving an "equivalent form" example for all items in the SQT. That would minimize the influence of test wiseness by making all soldiers wise to the peculiarities of testing. There appears to be no justification for surprises in test format and conditions. But specific answers to SQT items should be avoided. It is also desirable to insure adequate coverage of responses in a task, rather than focusing on a narrow set of responses.

Diagnostic Testing

The performance-oriented training model requires that each soldier be tested on every targeted task to indicate who needs further practice. The most efficient way to do this, apparently, would be to develop the equivalent form items along with the tests, and disseminate them to the units. The experts who develop the tests are the ones best qualified to develop the diagnostic material. That seems a formidable undertaking, admittedly, but modest in comparison with duplication of such effort in every battalion. Furthermore, the units generally lack personnel experienced in test development. Until those difficulties are overcome, it appears unlikely that units will use "practice-to-criterion," as required by the performance-oriented model.

There is every reason to believe that diagnostic testing could "close the loop," providing management information and highly specific practice. The result to be expected is nearly maximum scores on basic individual soldier skills.

Chapter 5

SUMMARY

A task classification was devised to help developers decide between multiple choice and performance testing for each task to be tested. The classification is comprehensive for all scoring units in three WC tests for different MOS (infantry, mortar infantry, and armor). A classification of test items was also developed for a similar purpose, because test developers should also consider what part of the task is being tested by a WC question.

"Mental" procedures (involving no items of equipment or significant features of the environment) are particularly easy to test with a multiple-choice format. Combat vehicle identification can also be tested with WC, using slides as stimulus material. Many small tactical decisions in combat, such as reacting to flares, can only be tested practically with WC, because setting up alternative situations in the field is infeasible. In testing procedures with weapons systems, the traditional forms of multiple choice are limited to sampling short segments of performance, and the visual environment may be hard to simulate. However, a special kind of multiple-choice problem was developed to overcome these limitations. This kind of item incorporates pictures of the equipment and standard forms, and a series of multiple-choice answers for successive steps in a task.

Improvements in training for SQT are suggested. In particular, some improvements in Soldier's Manuals are suggested, and a means of insuring that soldiers can find the information they need in preparing for SQT. Practice testing with equivalent form items is recommended in order to provide a valid and efficient practice, and to determine whether more practice is needed.

APPENDIX A

**Answer Sheet for M16 Plotting Board
and Reciprocal Lay of Mortar**

1 A B C D E	24 A B C D E	47 A B C D E	70 A B C D E	93 A B C D E	116 A B C D E	139 A B C D E
2 A B C D E	25 A B C D E	48 A B C D E	71 A B C D E	94 A B C D E	117 A B C D E	140 A B C D E
3 A B C D E	26 A B C D E	49 A B C D E	72 A B C D E	95 A B C D E	118 A B C D E	141 A B C D E
4 A B C D E	27 A B C D E	50 A B C D E	73 A B C D E	96 A B C D E	119 A B C D E	142 A B C D E
5 A B C D E	28 A B C D E	51 A B C D E	74 A B C D E	97 A B C D E	120 A B C D E	143 A B C D E
6 A B C D E	29 A B C D E	52 A B C D E	75 A B C D E	98 A B C D E	121 A B C D E	144 A B C D E
7 A B C D E	30 A B C D E	53 A B C D E	76 A B C D E	99 A B C D E	122 A B C D E	145 A B C D E
8 A B C D E	31 A B C D E	54 A B C D E	77 A B C D E	100 A B C D E	123 A B C D E	146 A B C D E
9 A B C D E	32 A B C D E	55 A B C D E	78 A B C D E	101 A B C D E	124 A B C D E	147 A B C D E
10 A B C D E	33 A B C D E	56 A B C D E	79 A B C D E	102 A B C D E	125 A B C D E	148 A B C D E
11 A B C D E	34 A B C D E	57 A B C D E	80 A B C D E	103 A B C D E	126 A B C D E	149 A B C D E
12 A B C D E	35 A B C D E	58 A B C D E	81 A B C D E	104 A B C D E	127 A B C D E	150 A B C D E
13 A B C D E	36 A B C D E	59 A B C D E	82 A B C D E	105 A B C D E	128 A B C D E	151 A B C D E
14 A B C D E	37 A B C D E	60 A B C D E	83 A B C D E	106 A B C D E	129 A B C D E	152 A B C D E
15 A B C D E	38 A B C D E	61 A B C D E	84 A B C D E	107 A B C D E	130 A B C D E	153 A B C D E
16 A B C D E	39 A B C D E	62 A B C D E	85 A B C D E	108 A B C D E	131 A B C D E	154 A B C D E
17 A B C D E	40 A B C D E	63 A B C D E	86 A B C D E	109 A B C D E	132 A B C D E	155 A B C D E
18 A B C D E	41 A B C D E	64 A B C D E	87 A B C D E	110 A B C D E	133 A B C D E	156 A B C D E
19 A B C D E	42 A B C D E	65 A B C D E	88 A B C D E	111 A B C D E	134 A B C D E	157 A B C D E
20 A B C D E	43 A B C D E	66 A B C D E	89 A B C D E	112 A B C D E	135 A B C D E	158 A B C D E
21 A B C D E	44 A B C D E	67 A B C D E	90 A B C D E	113 A B C D E	136 A B C D E	159 A B C D E
22 A B C D E	45 A B C D E	68 A B C D E	91 A B C D E	114 A B C D E	137 A B C D E	160 A B C D E
23 A B C D E	46 A B C D E	69 A B C D E	92 A B C D E	115 A B C D E	138 A B C D E	161 A B C D E

APPENDIX B

**Instructions on Reciprocal Lay of 81mm Mortar,
With Corresponding Section of Soldier's Manual**

TASK NUMBER: 071-321-3910

RECIPROCALLY LAY MORTAR USING M2 AIMING CIRCLE AND PLACE OUT AIMING POSTS

CONDITIONS:

Given an 81-mm mortar mounted on an initial azimuth with sight set on a deflection of 3200 for M53 sight (or 0 for M34A2 sight) and 1100 mils elevation; mortar laid on a direction stake with the traversing mechanism centered; assistant gunner, ammo bearer, and aiming posts; a prepared M2 aiming circle; and an operator (to give commands). The mounting azimuth will not be less than 150 mils nor more than 200 mils away from the initial azimuth.

STANDARDS:

1. Reciprocally laying mortars: Within 115 seconds, the sight will be set on last deflection given, 1100 mils elevation, and bubbles level. The vertical line of sight will be within 1 mil of the center of the head of the aiming circle.
2. Placing out aiming posts: Within 2 minutes from the command, "DEFLECTION 2800, REFER, PLACE OUT AIMING POSTS," the gunner will align both aiming posts on a deflection of 2800 mils, so that only the near post can be seen. The vertical crossline of the sight will be aligned on the left edge of the near stake. The far aiming post will be approximately 100 meters from mortar and the near post half the distance between mortar and far post.

PERFORMANCE MEASURES:

1. To reciprocally lay mortar:
 - a. The mortar will be mounted and laid on direction stake with sight set on 3200 mils deflection and 1100 mils elevation.
 - b. M2 aiming circle (AC) operator prepares aiming circle on azimuth of not less than 150 mils nor more than 200 mils from initial azimuth.
 - c. AC operator gives command "AIMING POINT THIS INSTRUMENT." (Figure 1.)

2-VIII-A-9.1

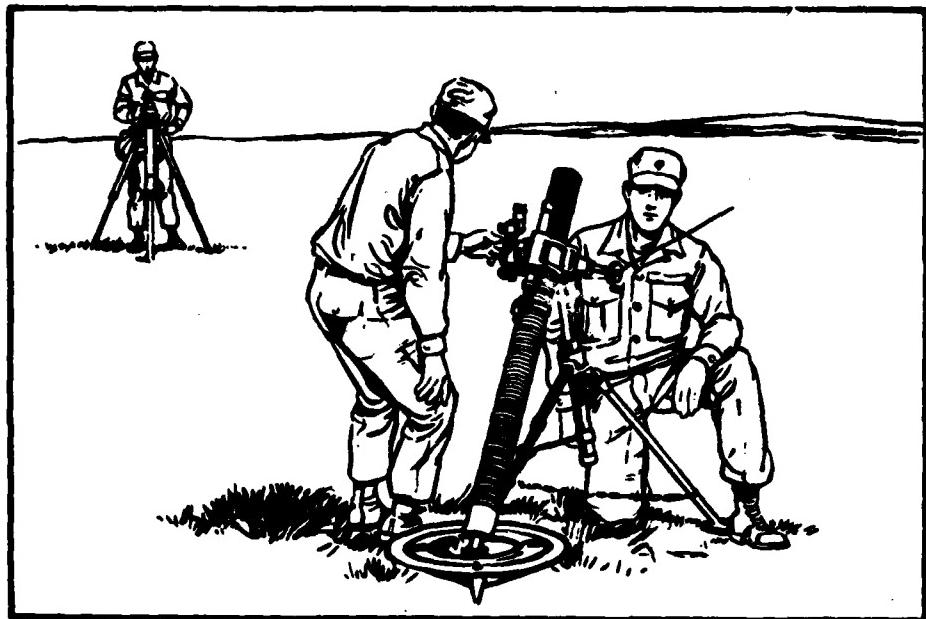


Figure 1.

NOTE: Gunner will repeat all commands from the AC operator.

d. Gunner refers sight (using the micrometer knob) to the AC and replies "AIMING POINT IDENTIFIED." (Figure 2.)

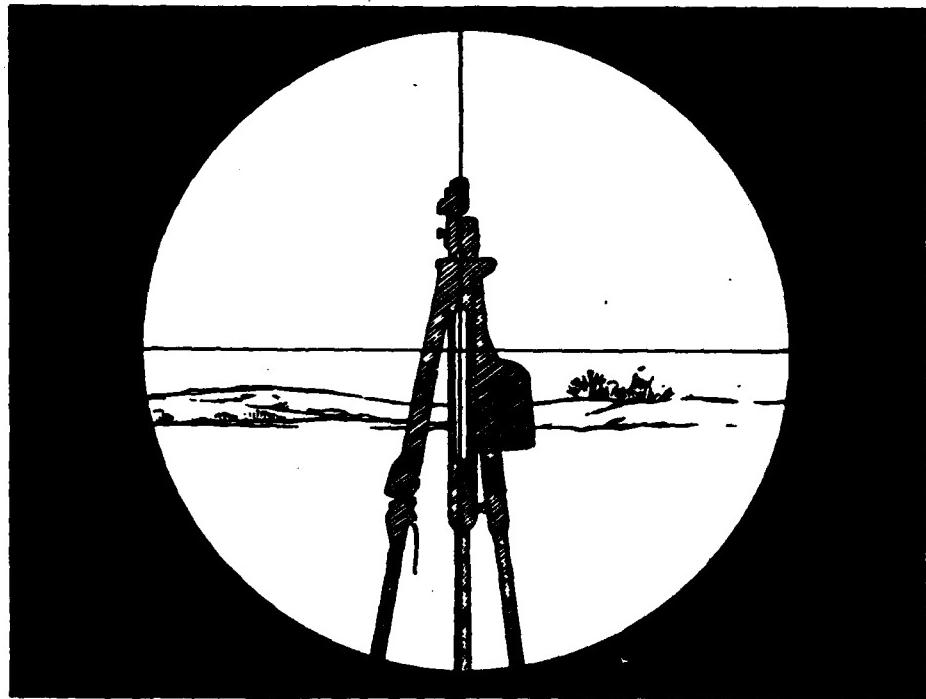


Figure 2.

2-VIII-A-9.2

e. AC operator announces deflection (example: "NUMBER ONE, DEFLECTION, 2315").

f. Gunner places data on sight using red scale and re-lays on center of AC's head, and announces "READY FOR RECHECK."

g. AC operator gives new deflection and process is repeated until gunner announces "NUMBER ONE, ZERO (OR ONE) MILS, MORTAR LAID."

NOTE: In laying a carrier-mounted mortar, if the first deflection given by the AC operator would cause the turntable and mortar to be moved from center of indexing gear, the carrier is shifted and the ammo bearer may repeat the message to overcome engine noise during exchange of deflections.

2. To place out aiming posts:

a. As soon as the gunner announces "ZERO (OR ONE) MILS, MORTAR LAID," the AC operator gives the command "SECTION, DEFLECTION 2800, REFER, PLACE OUT AIMING POSTS."

b. Gunner refers sight using deflection micrometer knob and indexes 2800 deflection on the red scale (this will move only the sight without moving the barrel).

c. Ammunition bearer moves out with aiming posts (100 meters far post; 50 meters near post).

d. Gunner directs ammunition bearer in placing out the aiming posts using arm-and-signals (figure 3) so he has an alined sight picture (figure 4).

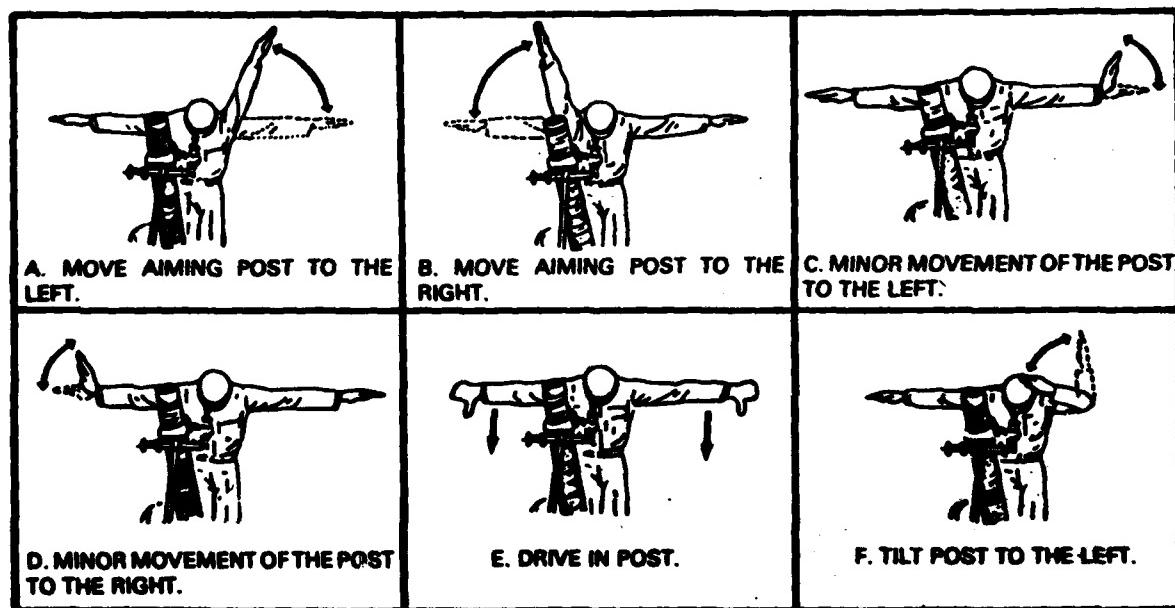


Figure 3.
2-VIII-A-9.3

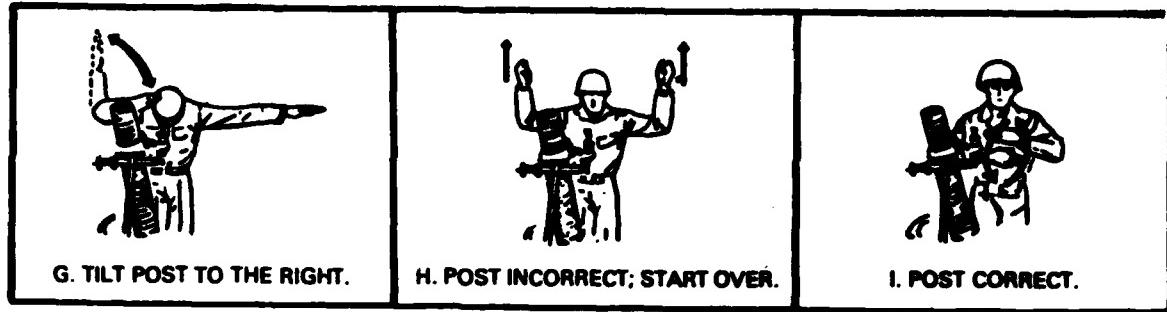


Figure 3. (CONT).

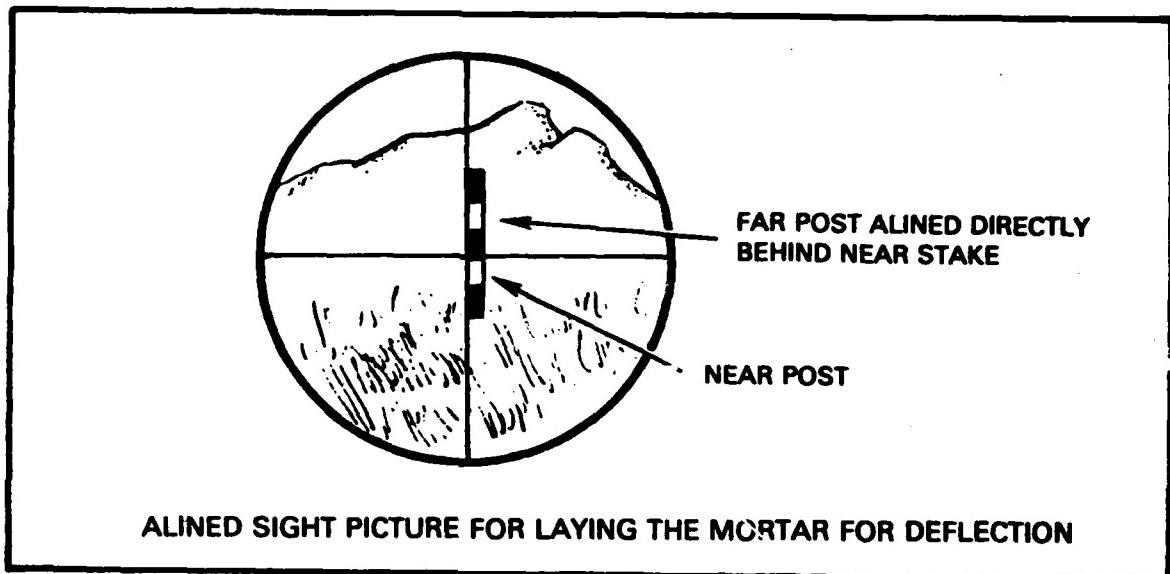


Figure 4.

REFERENCES:

FM 23-90, 81-mm Mortar, C1, Feb 72 (page 65, para 83; page 91)
TEC Lesson 010-071-6636, Prepare to Fire; Reciprocally Laying with M2 Aiming Circle

2-VIII-A-9.4

RECIPROCALLY LAY MORTAR USING M2 AIMING CIRCLE AND PLACE OUT AIMING POSTS

TASK NUMBER: 071-321-3910

1. Initial conditions. You are the gunner (Figure 1) and your 81mm mortar has a deflection of 3200 mils and an elevation of 1100 mils laid on the direction stake. Aiming Circle (A/C) operator says: "AIMING POINT THIS INSTRUMENT."

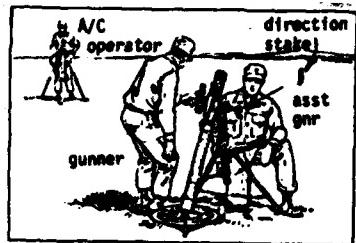


Figure 1.

2. Reciprocal Lay.

- a. Referring sight to A/C. Turn the deflection knob (Figure 2) until you see the A/C centered in your sight, like Figure 3. Then reply, "AIMING POINT IDENTIFIED."

- b. Setting deflection and relaying.

(1) Setting deflection. Suppose you are the first mortar in the section and the A/C operator says, "NUMBER ONE, DEFLECTION 2315." You repeat, "NUMBER ONE, DEFLECTION 2315." (Always repeat these deflection commands so that he knows you get the message.) Turn the deflection knob to 2315 (red scale) as shown in Figure 2. (The deflection knob moves both the micrometer and coarse adjust scales.)

(2) Relaying. First, have the assistant gunner take a position as shown in Figure 1. Have him help you lift the bipod legs just off the ground, while you move the mortar to center your sights approximately on the A/C (Figure 3). Re-level bubbles, both for elevation and for cross-level (Figure 2). Center precisely on A/C by turning traverse crank. (Two turns from center is the maximum allowable traverse; if you need anything close to that, center the traverse and begin this step again.) Then say, "READY FOR RECHECK."

(3) Adjusting deflection. Relaying your mortar may have changed the azimuth from A/C, so the A/C operator will recheck. Suppose he says next, "NUMBER ONE, DEFLECTION 2311." You repeat "NUMBER ONE, DEFLECTION 2311," turn deflection knob to 2311, and readjust traverse crank to center A/C lens in your sight. Then say, "READY FOR RECHECK."

Repeat this step until the deflection from A/C is within one mil of the previous one. For instance, if A/C operator says next, "NUMBER ONE, DEFLECTION 2310," you would reply, "ONE MIL, MORTAR LAID." (If there is no difference, you would say, "ZERO MILS, MORTAR LAID.")

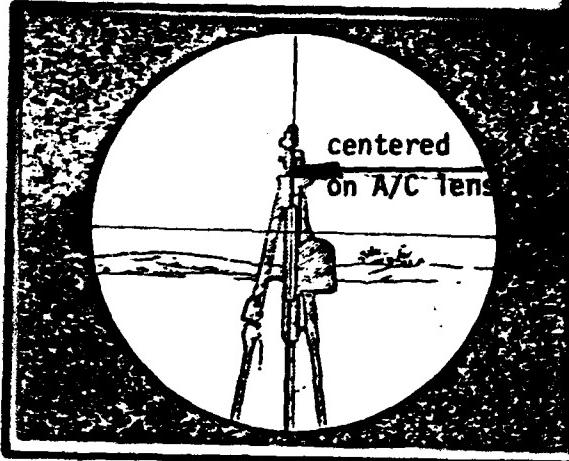


Figure 3

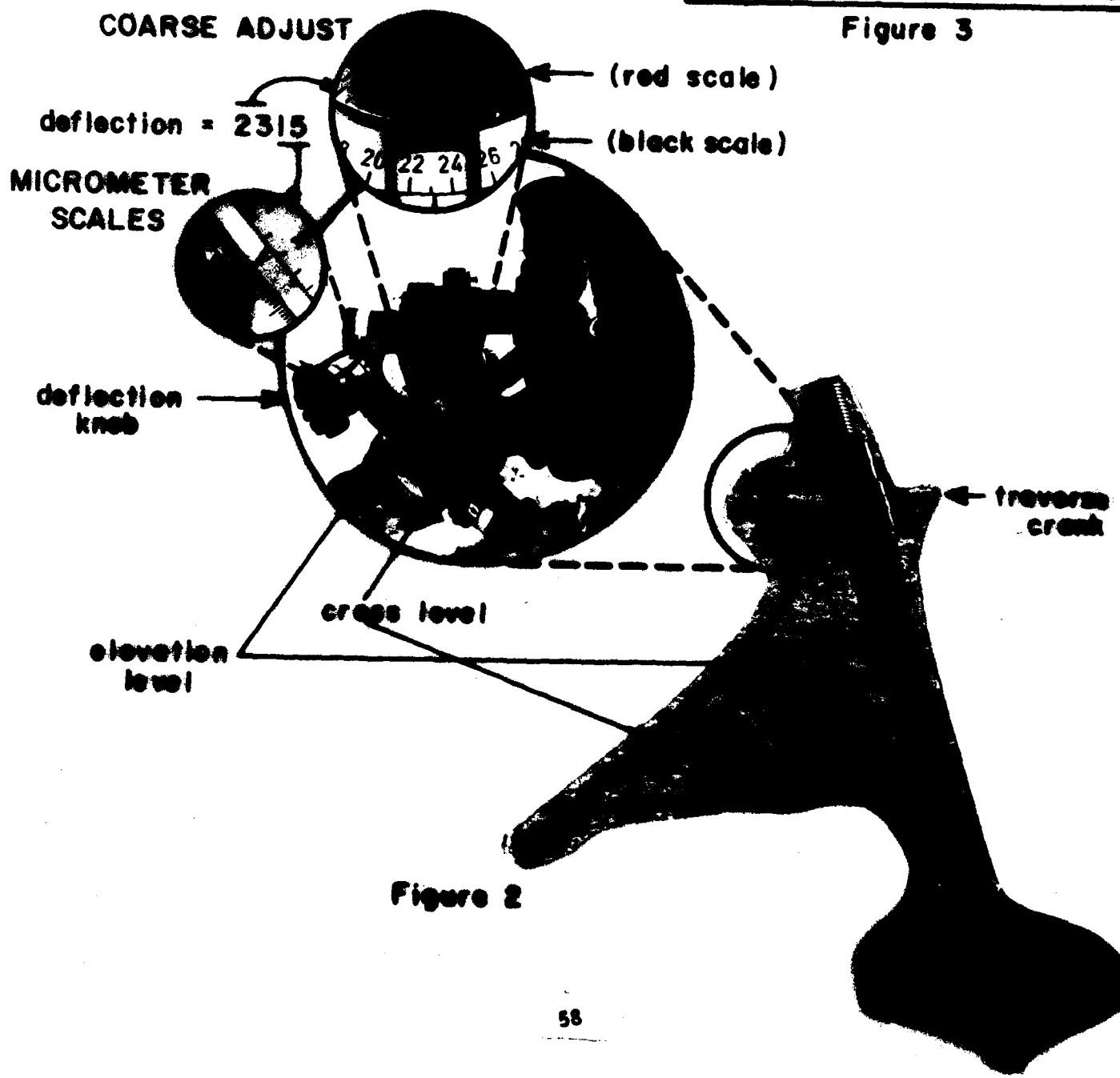


Figure 2

3. Placing out aiming posts. The A/C operator says: "SECTION, DEFLECTION 2800, PLACE OUT AIMING POSTS."

a. Referring sight. Turn deflection knob to 2800 on red scale. If that is an awkward direction for the aiming posts, use alternate method.

Alternate method. Turn deflection knob to a more convenient direction, and make minor adjustments so that the micrometer scale reads 0. Slip coarse adjust (black scale) to read 2800 mils, and thereafter read from the black scale. Keep a record of the red scale value that corresponds to 2800 mils on the black scale.

b. Placing posts. Have ammunition bearer pace out 50 meters along the 2800 mils deflection, and lay a post on the ground. Then have him pace off another 50 meters to place the 100 meter post. The exact distances are not critical, but the 50 meter post should be very close to halfway.

Guide the ammo bearer in placing the 100 meter post, using hand signals as illustrated in Figure 4. Then do the same with the 50 meter post.

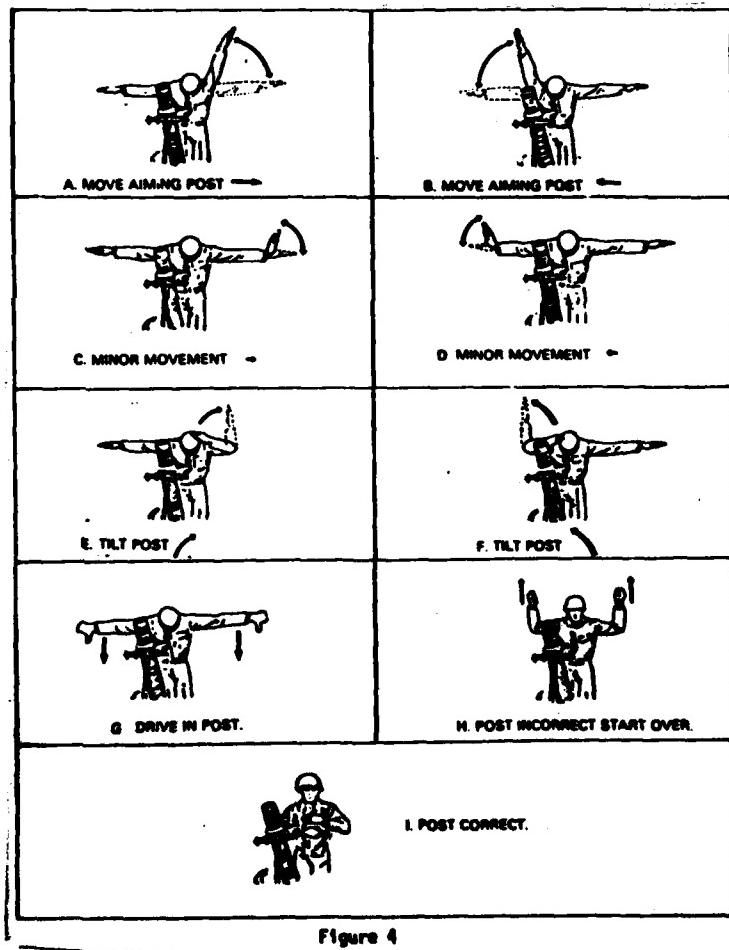


Figure 4